DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

Submission of Proposals

The responsibility for carrying out DARPA's SBIR Program rests with the Office of Administration and Small Business. The DARPA Coordinator for SBIR is Dr. Bud Durand. DARPA invites the small business community to send proposals directly to DARPA at the following address:

DARPA/OASB/SBIR
Attention: Dr. Bud Durand
3701 North Fairfax Drive
Arlington, VA 22203-1714
(703) 696-2448

The proposals will be processed in the Office of Administration and Small Business and distributed to the appropriate technical office for evaluation and action.

DARPA had identified 129 technical topics, numbered SB92-001 through SB92-129, to which small businesses may respond in the first fiscal year 1992 solicitation. Please note that these are the only topics for which proposals will be accepted at this time. Proposals can no longer be accepted on those previously advertised 160 technical topics which were numbered SB91-084 through SB91-243. A list of the topics currently eligible for proposal submission is included below, followed by full topic descriptions. The topics originated from DARPA technical offices.

DARPA's charter is to help maintain U.S. technological superiority over, and to prevent technological surprise by, its potential adversaries. Thus, the DARPA goal is to pursue as many highly imaginative and innovative research ideas and concepts with potential military applicability as the budget and other factors will allow. In the early years of the SBIR program most of the promising Phase I proposals could be funded, but as the program's popularity increased, this became more and more expensive. DARPA therefore instituted program changes to fund more Phase Is. These included increasing the number of SBIR topics, and setting more funds aside for Phase I proposals. In order to do this and still have a reasonable amount of funds available for the further development of promising Phase Is, the Phase II limit has been lowered to $250,000.

DARPA selects proposals for funding based upon technical merit and the evaluation criteria contained in this solicitation document. As funding is limited, DARPA reserves the right to select and fund only those proposals considered to be superior in overall technical quality and highly relevant to the DARPA mission. As a result, DARPA may fund more than one proposal in a specific topic area if the technical quality of the proposals in question is deemed superior, or it may fund no proposals in a topic area. Each proposal submitted to DARPA must have a topic number and can only respond to one topic.

DARPA has prepared a checklist to assist small business activities in responding to DARPA topics. Please use this checklist prior to mailing or hand carrying your proposal(s) to DARPA. DO not include the checklist with your proposal.

SB92-001 TITLE: Computational "Wind Tunnel" for Close in Combat Vehicle Dynamics

CATEGORY: Exploratory Development

OBJECTIVE: Develop design for, and establish feasibility of, a high speed computational methodology to investigate the aerodynamic environment of a flight vehicle undergoing rapid close in combat maneuvering.

DESCRIPTION: Computational simulations of aerodynamic flow characteristics associated with three dimensional air vehicle shapes undergoing rapid, multi axis maneuvering motions including post stall flight would be an invaluable design aid for future high performance flight vehicles – including manned and unmanned aircraft and missiles. Aircraft such as the X-31 are expected to pioneer dynamic maneuvering in the post stall regime. Future vehicles, including sophisticated tailless configurations employing enhanced thrust vectoring for control, may possess even greater maneuverability. Advanced computational methods could well surpass physical testing techniques due to the inherent difficulties in generating multiple degree of freedom motions in a flow facility and extracting useful aerodynamic data. A computational capability which integrates flow environment, vehicle structural behavior and propulsion effects would provide a new level of design insight and enhance optimization.

Phase I: Develop and study computational approaches which address complex vehicles undergoing multiple degree of freedom dynamic motions replicating advanced air combat maneuvers. These methods should examine external aerodynamic effects alone and in combination with combat maneuvers. These methods should examine external aerodynamic effects alone and in combination with structural behavioral and/or propulsion effects. Methods which couple vehicle flight mechanics with nonlinear unsteady aerodynamic behavior are also desired.

Phase II: Based on a promising concept, develop and implement a software design for investigating these flows. Demonstrate feasibility employing one or more relatively simple but illustrative test cases.

SB92-002 TITLE: Control Methodologies for Tailless Atmospheric Flight Vehicles

CATEGORY: Exploratory Development

OBJECTIVE: Develop flight control techniques which minimize the requirement for traditional aerodynamic surfaces on highly maneuverable atmospheric flight vehicles.

DESCRIPTION: Aircraft such as the X-31 Enhanced Fighter Maneuverability (EFM) demonstrator are expected to pioneer dynamic maneuvering in the post stall regime. These vehicles are equipped with enhanced thrust vectoring capability to provide necessary control authority at high angles of attack. Future atmospheric flight vehicles can be expected to exploit more fully these unique control capabilities eliminating the need for more traditional aerodynamic surfaces. Effective flight control algorithms and implementation schemes are needed to provide a basis for future designs and their evolution. These schemes should consider such factors as statistically unstable configurations and unsteady aerodynamic effects including rate dependent hysterics of the aerodynamic coefficient curves.

Phase I; Investigate candidate flight control methodologies. Develop promising algorithms including top level designs.

Phase II: Develop the most promising candidate design, including detailed design and software implementation. Test the design using computational simulation on a hypothetical flight vehicle and assess its performance and potential.

SB92-003 TITLE: Spacecraft Development Process Improvement

CATEGORY: Advanced Development

OBJECTIVE: Develop new techniques and approaches to streamline spacecraft design, manufacture, integration and test.

DESCRIPTION: The spacecraft development process can be characterized as complex and extremely man-intensive. Often times, the process is different from program to program, but not as a result of conscious attempts at improvement. Consequently, an overall review of current spacecraft design, manufacture, integration, and test is required to identify areas of improvement and inspire new concurrent engineering techniques and standardize approaches to streamline the development process. With the proliferation of computer aided design, engineering, and manufacturing techniques, an improved, flexible approach to spacecraft development can be created. This project will review existing spacecraft development methods, propose improvements, and create a comprehensive development plan, including the incorporation of computer aided engineering tools.

Phase I: Review current spacecraft development processes to identify areas of improvement. Propose a baseline development concept that streamlines all aspects of spacecraft design, manufacture, integration and test. Quantify time and cost savings. Identify existing and new concurrent engineering and system engineering tools needed to improve efficiency.

Phase II: Create a process handbook for spacecraft design, manufacture, integration, and test. Develop a comprehensive plan for building, integrating and demonstrating the computer-aided engineering tools.

SB92-004 TITLE: Remote Sensing for Climate Research and Tactical Surveillance

CATEGORY: Advanced Development

OBJECTIVE: Develop the requirements and payload concept for a small satellite optimized both to collect climatic and tactical surveillance information.

DESCRIPTION: Sensing climatic change from satellites has much in common with the increasing need for wide area, tactical surveillance. Currently, the designs of these systems diverge when the sensor is optimized to one or the other task. The goal of this project is to develop a payload sensor suite for small satellites that can identify climatic information and simultaneously perform tactical surveillance. The utility of climatic and tactical information that would be collected needs to be formulated as well as the on board processing and data compression algorithms and hardware required. Economic benefits of a combined sensor should be assessed.

Phase I: Define climatic data to be collected and explain its importance. Define the surveillance data to be collected and requirements that will satisfy both mission applications. Design the payload sensor at the functional level. Consider the technologies and approaches for on board data processing and compression. Generate cost and schedule to build a demonstration payload. Identify as potential problems, special constraints the sensor imposes on the rest of the system. Suggest approaches resolving each problem. Assess economic benefits of the sensor as compared with separate sensors.

Phase II: Develop an end to end simulation to demonstrate the sensor capability according to the design, cost and schedule of Phase I. The simulation will validate the sensor requirements and the design approach.

SB92-005 TITLE: MILSATCOM Network Simulation

CATEGORY: Advanced Development

OBJECTIVE: Develop an acquisition simulation tool for integrated Military Satellite Communication development to enable trade-offs based on satellite performance, cost, and O&M issues examining operational implications in a "combined architecture."

DESCRIPTION: Currently, there is no way to easily quantify the cost effectiveness and utility of improvements made to the MILSATCOM architecture by adding a new satellite or modifying existing satellites. There is also no method for performing trade studies to identify optimum satellite performance requirements versus overall architecture performance. The goal of this project is to develop a MILSATCOM simulator which allows the use to easily assess the utility versus life cycle cost of a new satellite in the architecture. The simulator, at a minimum, should take all MILSATCOM satellites, ground terminals, and satellite control segments into account.

Phase I: Identify parameters required in the simulator and prioritize parameters in order of importance. Identify existing software that can be integrated into the simulator. Develop top level, menu driven simulation architecture that accommodates most important parameters.

Phase II: Incorporate detailed parameters into a comprehensive MILSATCOM simulator.

SB92-006 TITLE: Spacecraft Reliability Study

CATEGORY: Advanced Development

OBJECTIVE: Develop alternate methods for specifying and predicting spacecraft reliability in lieu of current Military Standards.

DESCRIPTION: Spacecraft reliability specifications and predictions conforming to MIL-STD practices and procedures can be overly conservative, given the quality of current electronic piece-parts. Consequently, this potential for over-specification may result in costly design implementations and preclude the use of commercially available piece parts and components. MIL-STD practices also slow the insertion of new technology into spacecraft. This project will review existing MIL-STD reliability specification, prediction and part usage methods, propose improvements, and create a new spacecraft reliability prediction handbook.

Phase I: Assess current military reliability specification and analysis procedures and develop new procedures based on current manufacturing standards and best commercial practices.

Phase II: Develop a spacecraft reliability handbook with new procedures for specifying and analyzing the use of off the shelf components.

SB92-007 TITLE: Small Satellite Cost Estimating

CATEGORY: Advanced Development

OBJECTIVE: Provide an interactive, menu-driven computer model facilitating the integrated design and cost assessment of small satellites from system level requirements.

DESCRIPTION: Current satellite and launch vehicle cost models are oriented to the full size satellites and their corresponding launch vehicles and are decoupled from the design process. An integrated design and cost model for the small satellite and booster class of vehicles is needed to reflect the development considerations and technology usage that are particular to this community. Commercially available packages and languages will be used whenever possible. The user interface will consist of large, easy to read menus. Menu selections will allow for user customization of satellites and launch vehicles down to the component level. Users will be able to specify items such as weight range, altitude and plane of orbit, type and complexity of mission, type of power subsystem, commercial availability of piece parts, launch time of year, etc.

Phase I: Identify the parameters necessary for technical design and top level costing of small satellites and the prioritizing of those parameters into the appropriate order of importance. Develop a top level integrated design and cost estimating model. Identify and acquire relevant historical data and compile this data into a formal structured database. Also include a simple, but functional menu driven user interface with submenu branching, to one additional level.

Phase II: Further refine the integrated design and cost estimating model. Incorporate a more complicated series of branching submenus. Provide default choices of systems, subsystems and components for users who wish to design a more general product, and provide the capability of specifying to the piece part level for users who wish a more customized product. Validate the model and cost estimating relationships against actual data from small satellite programs.

SB92-008 TITLE: Fiber Optic Gyroscope Manufacturability

CATEGORY: Advanced Development

OBJECTIVE: Provide exploratory development model fixtures, devices, and techniques designed to reduce the current cost estimates of fabricating interferometric fiber optic gyroscopes from less than $1000 per axis to less than $100 per axis level.

DESCRIPTION: The feasibility of producing navigation-grade, all solid state IFOG's has been demonstrated in the laboratory and is rapidly moving towards the flyable brass board stage. This technical breakthrough has been achieved by the use of miniature integrated optical circuitry, and all solid state optical sources. In order to achieve the low cost potential of this technology by the mid 90s, it is necessary to develop robotic/quasi-robotic, high rate of production machinery and methods capable of being installed and tested in a factory environment within the next 3-5 years. Example manufacturing areas requiring significant technical advancement are: precision alignment of MIOC to polarization maintaining fiber interconnections, and PM fiber to fiber splices; precision alignment of optical source to PM fiber pigtail; and, automatic environmental testing of completed IFOG subassemblies.

Phase I; Select and design a robotic/quasi-robotic assembly process capable of significantly lowering the manufacturing cost of IFOGs. Justify the selection and quantify cost savings.

Phase II: Fabricate and demonstrate a laboratory version of the Phase I design.

SB92-009 TITLE: Advanced Displays for Post Stall Maneuvering Fighters

CATEGORY: Exploratory Development

OBJECTIVE: Develop cockpit aids, including advanced displays, which enhance pilot performance during dynamic, PST maneuvering flight.

DESCRIPTION: Aircraft such as the X-31 enhanced fighter maneuverability are expected to pioneer dynamic maneuvering flight in the extremely high angle of attack, PST regime. This flight environment is expected to be highly disorienting to pilots and will probably induce a significant loss of visual situational awareness due to rapid, large amplitude changes in vehicle orientation. Cockpit aids, including visual displays, may well provide significant performance enhancement to pilots employing these close in combat tactics, as well as serve as effective training aids.

Phase I: Study alternative displays and other cockpit mounted devices capable of enhancing pilot performance during dynamic PST maneuvers. Establish related evaluation criteria to assess performance of these devices. Systematically evaluate the concepts.

Phase II: Design, fabricate, and test a promising representative device. Demonstrate capability in a ground simulation or, if possible, a flight demonstration.

SB92-010 TITLE: High Repetition, High Power "Blue" Optical Sources

CATEGORY: Advanced Development

OBJECTIVE: Provide an exploratory development model optical source designed to provide variable color, high power "Blue" light at a high repetition frequency.

DESCRIPTION: The Department of Defense has been developing new and novel means for space-based/airborne two way communications to a submerged submarine. Recent analyses of laser based communications systems suggest that a frequency agile, high power, high repetition rate optical source could be useful in achieving this goal. This source should be color tunable between nominal rates.

Phase I: Design a high power optical source capable of being tuned between rates. All solid state devices are preferred.

Phase II: Fabricate and demonstrate a laboratory version of the Phase I design.

SB92-011 TITLE: Commercial Components for Satellites

CATEGORY: Advanced Development

OBJECTIVE: Identify specific opportunities and assess feasibility of using commercial technology and components in space applications.

DESCRIPTION: Currently, spacecraft components are expensive and trailing behind the state of the art of similar commercial technology. Components are custom designed so that they can tolerate the spacecraft environment. Some commercial components, however, can withstand the space environment as they are currently commercial manufactured, or could survive with small modifications in packaging or electronic parts selection. The goal of this effort is to identify specific opportunities for using commercial components in satellite applications and demonstrate their ability to perform in the space environment.

Phase I: Identify and analyze candidate commercial components based on their ability to survive and operate in the spacecraft and launch environment with minimal modification. Recommend required minimal modifications when necessary.

Phase II: Perform minimal modifications to selected commercial components as identified in Phase I, and using DOD Handbook 343 for guidance, environmentally test the selected candidate components.

SB92-012 TITLE: Interactive Flight Vehicle/Ground Simulator Network for Close in Combat Evaluation

CATEGORY: Advanced Development

OBJECTIVE: Develop and implement methodology to link high performance airborne vehicle(s) with manned or unmanned ground-based air vehicle simulators to replicate close in combat conditions and evaluate tactics.

DESCRIPTION: Aircraft such as the X-31 Enhanced Fighter Maneuverability demonstrator are designed for a high degree of agility to enhance effectiveness in close in aerial combat. Anticipated maneuver tactics of these types of vehicles involves rapid motions and excursions to large angles of attack, as well as extremely close proximity of combatants, thus creating a potentially hazardous flight environment. The ability to electronically link a high performance airborne vehicle with a manned or unmanned ground based air vehicle simulator to replicate an air battle would provide an invaluable aid for pilot training, close in combat, tactics evaluations, and benign conditions. The development of a network and real time methodology capable of linking single or multiple ground simulators

with an in flight vehicle is desired. Implementation should consider such factors as simulated vehicle performance models and their limitations, vehicle tracking and orientation, pilot awareness – both airborne and simulator-bound, simulated weapons modeling, and availability of advanced hardware/software technologies.

Phase I: Develop a refine several network concepts and approaches to implementation.

Phase II: Develop a preliminary design for a selected concept, including an evaluation of development risk factors. Demonstration of key technology elements may be required in this phase.

SB92-013 TITLE: On Board Spacecraft Data Architecture

CATEGORY: Advanced Development

OBJECTIVE: Develop on board spacecraft data architectures featuring simple, well defined interfaces based on commercial and/or military standards.

DESCRIPTION: Traditional spacecraft data architectures are unique to each spacecraft. Interfaces are not standardized and data busses are seldom employed. Current architectures do not allow for rapid insertion of advanced technologies. Design, test, and integration of these architectures is length and expensive. This project will result in the development of on-board spacecraft data architectures that are scaleable to small, medium, and large spacecraft. Designs should address spacecraft environmental issues while minimizing weight, power, and volume and improving performance where needed. Architectures should feature simple, well defined interfaces based on commercial/military standards, as well as commercial components to significantly reduce overall spacecraft design, integration, and test cost, and enable rapid advanced technology insertion.

Phase I: Evaluate commercial literature to identify candidate technologies which can be incorporated into spacecraft architectures. Define candidate architectures based on spacecraft environment, power, weight, volume, cost and performance.

Phase II: Breadboard and test the selected Phase I candidate architecture using Department of Defense for guidance.

SB92-014 TITLE: Advanced MILSATCOM Terminal Concepts

CATEGORY: Advanced Development

OBJECTIVE: Investigate innovative concepts for common, modular Military Satellite Communication terminals emphasizing the use of commercial components.

DESCRIPTION: Current MILSATCOM terminals are expensive to manufacture, operate, and maintain. The focus of this project is to develop modular terminal subsystem building blocks that are frequency-independent and can be used in any terminal. These modules should be designed with commercial components where feasible, to reduce terminal cost. Common interfaces within terminals, to take advantage of these modular building blocks, should also be addressed.

Phase I: Develop system-level modularity concepts for MILSATCOM terminals and characterize the life cycle cost advantage of building terminals in a modular fashion. Define standard interfaces within the terminals. Identify the technology which needs to be developed.

Phase II: Conduct detailed performance and cost trade-offs and further refine the system and subsystem design. Analyze the manufacturability, maintainability, and interoperability of the subsystem terminal modular building blocks.

SB92-015 TITLE: Lightweight, High Resolution, Stereographic Head Wrong Display System for Computer Generated Imagery

CATEGORY: Advanced Development

OBJECTIVE: Demonstrate innovative lightweight, self contained capability to display real time stereographic, computer generated imagery.

DESCRIPTION: The Defense Advanced Research Projects Agency (DARPA) is investigating advanced technologies and concepts for providing a compact, lightweight, high resolution display device for operators to wear as interface to computer generated synthetic environments. A typical system would be a small and self contained stereo vision system, the size of ski goggles, capable of operation with minimal connection to external power and data sources. It might utilize rechargeable batteries with an electro-optical or radio frequency data link. The display would be full color, maximum resolution possible, capable of being driven with minimal hardware and software interfacing to commercial off the shelf computer graphics generators.

Phase I: Provide detailed analysis of the functional design of the proposed hardware technologies to be incorporated in an innovative lightweight, self contained capability to display via head worn system real time color stereographic imagery. Describe the necessary integration for the operational incorporation of the system into a computer generated synthetic environment system.

Phase II: Develop a feasibility demonstration model of the system concept and demonstrate its performance.

SB92-016 TITLE: Low Cost Multispectral Signal Processing to Simultaneously Process Spatially and Temporaneously Disjoint Wideband Signals

CATEGORY: Advanced Development

OBJECTIVE: Demonstrate innovative low cost multispectral signal processing using multichannel electro optical brag cells to simultaneously process spatially and temporaneously separate wideband signals.

DESCRIPTION: The Defense Advanced Research Project Agency (DARPA) is investigating advanced technologies and concepts for providing tactically useful techniques for processing wideband data hidden signals, spread both spatially and temporaneously. Such signals might result from multi-emitter, since-receiver battlefield surveillance systems. One potential candidate might include using multi-channel EO brag cells. Strong emphasis will be placed on truly innovative concepts that offer the potential for significant improvement in capability, even if there is technological risk. Proposals must include a discussion of how the technology would be operationally utilized.

Phase I: Provide detailed analysis of the functional design of the proposed technologies to be incorporated in an innovative tactical signal processing system. Include a prediction of the operational utility of the processing technique.

Phase II: Develop a feasibility demonstration model of the system concept and demonstrate its performance.

SB92-017 TITLE: Low Cost, Self Contained, 6 Degree of Freedom Orthometric Localization Orientation System (OLOS)

CATEGORY: Advanced Development

OBJECTIVE: Demonstrate innovative low cost, lightweight, self contained head and/or hand finger position sensors and processing capable of resolving 1 are minute in pitch, roll and yaw, and 1 millimeter in vertical lateral and longitudinal position.

DESCRIPTION: The Defense Advanced Research Projects Agency (DARPA) is investigating advanced technologies for measuring real time displacement and orientation of a human operator's head, eye, hand, and fingers while operating in a computer generated synthetic environment. DARPA is interested in innovative sensor and processing technologies to detect and classify small and large scale movements in real time. Possible approaches could include use of magnetic, radio frequency or electro optical emitters, and detectors coupled with innovative signal processing techniques. Strong emphasis will be placed on truly innovative concepts that offer the potential for significant improvement in capability, even if there is technological risk. Proposals must include a discussion of how the technology would be operationally utilized.

Phase I: Provide detailed analysis of the proposed OLOS detection and tracking sensor technique based on physical principles, as well as an analytical assessment of any available experimental data. Include a plan for how OLOS data would be output to be used by its synthetic environment.

Phase II: Develop a feasibility demonstration model of the system concept, and demonstrate its performance.

SB92-018 TITLE: Miniature Integrated Optical Circuit Technology Enhancement

CATEGORY: Advanced Development

OBJECTIVE: Develop new methods and subassemblies for fabricating miniature optical circuit components having performance characteristic at least a factor of 10 better than is currently available.

DESCRIPTION: The Department of Defense has been developing new and novel military devices for various applications, which require the use of miniature integrated optical circuitry. Currently the theoretical performance of a complete MIOC device can be achieved because of current fabrication techniques used to make the individual devices are immature or non optimal. This project is expected to result in new device fabrication technology, capable of impacting the development of fiber optic gyroscopes or signal processing units the DoD is envisioning for future military implementation.

Phase I; Develop a new procedures or design a new devices capable of improving MIOC component fabrication to a level such that a factor of 10 component performance enhancement is achieved. Justify component selection and quantify the amount of performance gain potentially achievable.

Phase II: Fabricate and demonstrate a laboratory version of the Phase I designs.

SB92-019 TITLE: Modulation and Coding Design to Provide Two Orders of Magnitude Improvement in Meteor Burst Communication Throughput, Wait Time, and Low Probability of Intercept (LPI)

CATEGORY: Exploratory Development

OBJECTIVE: Design, develop, and demonstrate modulation, coding, and link protocols with two orders of magnitude improvement in throughput, waiting time and LPI compared with military standards performance while maintaining compatibility with current frequency allocations.

DESCRIPTION: Concepts are sought for modulation, coding, and link protocols what will optimize communication performance for the meteor channel for three broad application areas: high throughput to support voice and data; low wait time for 200 character messages; and for users that require LPI communication. Novel communication designs should take advantage of new antenna/RF technology that provides 70 dbw link Effective Radiative Power 9ERP) and acquisition windows of 90 degrees. The schemes that maximize throughput or minimize wait times are to be constrained by current frequency allocations to 20 or 40 khz. LPI techniques must be mutually compatible with current users of the VHF band. Concepts will be reduced to practice, implemented in a machine to run in real time, interfaced with RF equipment, and demonstrated on the air in conjunction with MB adaptive antennas, over a variety of ranges.

Phase I: Design a proof of concept system and provide detailed descriptions, design and performance analyses of the modulation/coding/link protocol schemes that provide the desired performance improvements for a two way 70 dbw ERP link.

Phase II: Implement the schemes in software and hardware and support the integration, testing and evaluation of the proof of concept system.

SB92-020 TITLE: Low Cost Self Contained GPS based Aircraft Location Transponder

CATEGORY: Advanced Development

OBJECTIVE: Demonstrate innovative lightweight, self contained capability to transmit ownship location via a C Band like transponder.

DESCRIPTION: The Defense Advanced Research Projects Agency (DARPA) is investigating advanced technologies and concepts for providing operationally meaningful detailed position management information for dynamic, multi vehicle flight environments. A typical system would be small and lightweight, capable of operation with minimal connection to external power and/or data sources. It might adapt in some configurations to utilize rechargeable batteries in conjunction with solar cells. It might adapt in some configurations to utilize rechargeable batteries in conjunction with solar cells. It would have capability to receive Global Positioning System data and compute and transponder ownship state vector data, including altitude, airspeed and heading, as well as longitude and latitude. It might also compute and transponder ownship orientation of roll, pitch and yaw, based upon solid state or optical accelerometers and gyros. It should have data output ports and an optional, separate recorder which can be connected for long term storage of the ownship position data, when desired. The operating in uncontrolled environments. Any integrated data processing software should be contained in plug in solid state modules to permit replacement or upgrade of the software. Proposals must include a discussion of how the technology would be operationally utilized, and how the transponder data from multiple vehicles in a dense, dynamic airborne environment would be acquired and processes for aircraft flight management.

Phase I: Provide detailed analysis of the functional design of the proposed hardware technologies and requisite software to be incorporated in an innovative lightweight, self contained capability to transponder and record ownship location information.

Phase II: Develop a feasibility demonstration model of the system concept and demonstrate its performance.

SB92-021 TITLE: Low Cost Self-Contained Ground Impact Trajectory Detection System

CATEGORY: Advanced Development

OBJECTIVE: Demonstrate innovative airborne sensor systems for the detection and prediction of undesirable ground impact trajectories using AI predictive ground avoidance trajectory evaluation and warning.

DESCRIPTION: The Defense Advanced Research Projects Agency is investigating advanced technologies for detecting and predicting from onboard airborne platforms, both manned and unmanned vehicles, undesirable trajectories resulting in ground impact. Airborne sensing of the undesirable trajectory trend would provide warning to air vehicle operators for modifying the trajectory prior to ground impact. The Ground Impact Trajectory Assessment and Warning system should provide more than ground collision avoidance through the incorporation of intelligent interference of trajectory behavior based up on a priori knowledge of the air vehicles' flight profiles, characteristics and purpose. Real time trajectory trend data from self contained GITAW inertial reference would be tracked against a priori knowledge of acceptable flight profiles. Examples might be that the system would recognize weapon delivery dive bomb trajectories as benign, while 1 gravity descending turns as incipient to death spirals. System concepts should provide for self contained inertial reference, possibly using combinations of Global Positioning System receiver system and optical/solid state gyros and accelerometers. Possible approaches could include use of innovative signal processing and kalman filter techniques. The systems must provide self contained

software and hardware for intelligent trajectory assessment processing. Any integrated data processing software should be contained in plug in solid state modules to permit replacement or upgrade of the software. The system must have output ports and input/output control appropriate to the system concept output data, but consistent with commercial practices for data transfer among avionics systems onboard current generation military air vehicles. Systems must be able to be adapted to a variety of platforms through the software loading of air vehicle parameters. Although system accuracy, performance and lack of false alarms is of primary concern, low cost, low power, low maintenance and lightweight system concepts provide greatest potential for integration across military and commercial vehicles. Strong emphasis will be placed on truly innovative concepts that offer the potential for radical leaps in capability, even if there is technological risk. Proposals must include a discussion of how the technology would be operationally incorporated into air vehicles and utilized.

Phase I: Provide detailed analysis of the proposed detection, and processing techniques to be used to determine that the air vehicle is undergoing an incipient ground impact trajectory, based on physical principles as well as an analytical assessment of any available experimental data on typical flight profiles. Provide detailed analysis of the functional design of the proposed hardware technologies and requisite software to be incorporated in the GITAW system. Describe system test considerations and effort required for incorporation for flight test. Include a plan for how GITAW data could be output to be used by its airborne platform.

Phase II: Develop a feasibility demonstration model of the system concept and demonstrate its performance.

SB92-022 TITLE: Small, Low Cost, Remote Controlled, Turbojet Powered Avionics Test bed

CATEGORY: Advanced Development

OBJECTIVE: Demonstrate innovative small, low cost, remote controlled, turbojet powered avionics test bed for concept evaluation of small avionics systems.

DESCRIPTION: DARPA is investigating advanced technologies for testing new small avionics systems for airborne platforms, both manned and unmanned vehicles. Airborne testing of avionics concepts provides incremental system evaluation without reliance on more expensive end product platforms. The Inexpensive Turbojet Avionics Platform (ITAP) would provide light behavior knowledge of the component technologies of future missile and air vehicle avionics, without the strenuous requirements of man rating components for flight test on manned vehicles. Candidate avionics for test on ITAP include small self-contained guidance packages, sensor systems, miniature high performance computer systems, battery technologies, transmitters, receivers and antennas. Remote control of ITAP should be independent of the avionics under test ,with the ITAP air vehicle merely providing the platform for obtaining flight conditions. No avionics will be integrated within ITAP. ITAP should be ground launched, recoverable and recycled for further launches with minimal labor, time and resources, at industrial and remote locations. System concepts should provide for the air vehicle, remote control system and launch, recover and recycle techniques. The full up air vehicle should be two man portable without special handling equipment. The air vehicle should be able to fly and be controlled at airspeeds up to 250 knots, with mission durations up to 30 minutes, at altitudes up to 5000 feet above ground level. The air vehicle must provide for up to 25 pounds and 750 cubic inches of avionics test components. Typical ITAP fuselage diameters should encompass no less than 5 inch diameter avionics packages. Electrical power supplied by the turbojet is desirable, but not required. The remote control system should provide for line of sight control beyond the range of average visual acuity. Possible ITAP approaches could include use of innovative scaled aircraft models powered by commercially available miniature turbojet engines. Composite or other non metallic material construction of the air vehicle is desired. Although performance and controllability are of primary concern, low cost and low maintenance solutions provide greatest potential for long term use as avionics test beds. Strong emphasis will be placed on truly innovative concepts that offer the potential for significant improvement in avionics testing capability, even if there is technological risk. Proposals must include a discussion of how the technology would be effectively utilized.

Phase I: Provide detailed analysis and design of the proposed ITAP air vehicle system, including launch, recover and recycle technique, and turbojet and remote control systems to be utilized. Describe system test considerations and effort required for incorporation of avionics components for flight test.

Phase II: Develop a feasibility demonstration model of the system concept and demonstrate its flight, recover and recycle performance, while incorporating an operating, generic avionics system component for evaluation.

SB92-023 TITLE: Transform Mission Planning into Classical Mechanics Domain

CATEGORY: Advanced Development

OBJECTIVE: Transform and redefine the threat avoidance mission planning problem from an operational research paradigm into an analytical domain resolvable through the precepts of classical Hamiltonian and Lagrangian mechanics.

DESCRIPTION: The Defense Advanced Research Projects Agency (DARPA) is investigating advanced mathematical concepts and computational techniques for providing tactically useful on board aircraft mission planning systems for real time threat avoidance. DARPA is interested in innovative mathematical and computational schema for moving the planning problem away from dynamic programming techniques to a functional redefinition of the problem as an N-Space multi variable non linear, probabilistic state space that can be numerically solved with next generation high throughput computers. Techniques of interest might include categorizing the threat and cost functions as bounded. N-Space curves and surfaces with extrapolation of energy relationships and gradient techniques for path finding. Analogies to physical systems such as steel balls finding their way down inclined, mountainous surfaces might be appropriate.

Phase I: Provide detailed analysis of the mathematical techniques to be used and transformation and redefinition to be performed. Include a prediction of the operational utility of the mathematical construct and computational technique to implement it.

Phase II: Develop a feasibility demonstration model of the mathematical and computational system concept and demonstrate its performance.

SB92-024 TITLE: Unsteady Aerodynamic Measurement Techniques for Dynamic, Post Stall Maneuvering Flight Applications

CATEGORY: Exploratory Development

OBJECTIVE: Develop novel, effective methods for characterizing aerodynamic behavior and performance of highly maneuverable flight vehicles undergoing large amplitude, unsteady motions.

DESCRIPTION: The next generation of high performance atmospheric flight vehicles is expected to incorporate dynamic, PST maneuvering capabilities for enhanced close in combat effectiveness. Unsteady aerodynamic measurement techniques capable of extracting relevant flow field, surface and vehicle performance parameters are necessary to support laboratory and flight test investigations. Such techniques may also provide the basis for a new generation of instruments to support operational flight, supplementing or replacing existing sensors and instrumentation.

Phase I: Study novel approaches to laboratory and in flight measurement techniques to assess unsteady aerodynamic effects arising from large amplitude vehicle motions. Provide a detailed specification for a selected, representative system including rationale for selections, as well as a design and fabrication feasibility assessment.

Phase II: Design, fabricate and test a prototype sensor to evaluate concept viability and establish performance limitations.

SB92-025 TITLE: Application of High Temperature Superconductors to Compact High Frequency Antenna Arrays

CATEGORY: Basic Research

OBJECTIVE: Evaluate methods of fabricating compact, low profile high frequency antennas capable of vehicular operation. The method should be based upon the application of high temperature superconductors.

DESCRIPTION: There is a need for compact, low profile antennas in the regime from 3 to 30 MHz which could be mounted conveniently on aircraft and/or ground vehicles. Vehicles equipped with such a compact antenna would be capable of jamming and employing other electronic countermeasures while on the move and, consequently, would have a substantially increased survivability. However, the Q for conventional compact HF antenna designs is too high, resulting in narrow bandwidths. For the mobile application being considered, a bandwidth of 1.5 to 30 MHz would be highly desired. Antenna systems fabricated with high temperature superconductors can yield an electrically small element that has a high radiation efficiency, but also has a substantially reduced bandwidth.

Phase I: Address the utilization of high temperature superconductors in HF antennas by considering means of broad banding without sacrificing radiation efficiency. The Phase Proposals should provide the basic scheme for electromagnetic propagation, and the work itself should complete a design study to construct such an antenna, considering mechanical requirements and cooling.

Phase II: Construct an antenna based on the design study of Phase I.

SB92-026 TITLE: Applications of Fullerene Chemistry

CATEGORY: Exploratory Development

OBJECTIVE: Explore the possibility of developing useful technological applications involving the use of Fullerenes such as C-60.

DESCRIPTION: Fullerenes form a series of new allotropes of carbon that have a variety of fascinating properties. Proposals are sough to identify and demonstrate the feasibility of using Fullerenes in novel applications. Other issues, such as the investigation of fundamental properties and structure, synthesis and purification, chemical reactions, electrochemistry, conductivity, and the superconductivity of these materials, as they relate to the intended application, should be addressed in the proposal.

Phase I: Demonstrate the feasibility and utility of using Fullerenes in the intended application.

Phase II: Test the performance of these novel materials in the intended application.

SB92-027 TITLE: Ceramic Shields for Satellite Protection against Hypervelocity Impact

CATEGORY: Basic Research

OBJECTIVE: Explore the use of ceramics in stand off shields for protecting satellites against hypervelocity impacts by orbital debris and/or kinetic energy pellets.

DESCRIPTION: Subsequent to deployment, a number of important and costly space systems will be subject to impacts from projectiles traveling at relative velocities as high as 15-20 km/sec. In peacetime, the primary source of such hypervelocity projectiles is man made orbital debris. In wartime, hostile offensive action may result in the addition to this debris environment of projectiles such as the pellets and fragments from the breakup of other satellites. TO protect these space systems, effective debris impact shields must be designed and implemented. Since the impact velocities exceed considerably the capabilities of current ground launcher technology, the design and analysis of such shields must rely heavily on the extension of laboratory impact data from moderate to high

impact velocities by computer simulations of impact events. In an effort to optimize shield performance, DARPA is exploring the use of certain classes of materials which offer the potential for major improvements in shield capability. Of particular interest are ceramics. Examples include lightweight ceramic armor and ceramics with microstructure. Accordingly, it is the intent of this research topic to identify and demonstrate the advantageous use of ceramics in advanced shield designs.

Phase I: Identify a promising application of ceramics which would enhance significantly the performance of stand-off shields against hypervelocity impact by projectiles with masses up to 1-2 gm and relative velocities in the 5-20 km/sec regime. Provide a preliminary design, and demonstrate the enhanced capability via theoretical analysis and/or computer simulations. While the concept may be explored theoretically/numerically in this study, the use of laboratory experiments for demonstrating feasibility at some level, or investigating critical technical issues, is not excluded.

Phase II: Demonstrate the capabilities of one or more candidate shield designs with the aid of large-scale computer simulations of impact events and appropriate laboratory experiments.

SB92-028 TITLE: Ceramic Fiber Development

CATEGORY: Exploratory Development

OBJECTIVE: Develop low cost manufacturing methods for ceramic fibers with properties suitable for use in advanced metal and ceramic matrix composites.

DESCRIPTION: Ceramic fiber/metal matrix and ceramic fiber/ceramic matrix composites have been identified by the Department of Defense as important to the development of advanced military systems. Widespread use of components made from these composites will depend upon the availability of low cost/high performance fibers. For thermo structural applications of interest to the Defense Advanced Research Projects Agency (DARPA), fibers must maintain high strength and creep resistance at temperatures up to 1500 C. Innovative methods capable of producing wearable fibers are of particular interest.

Phase I: Provide a bench scale demonstration of process, capable of producing fibers with the desired high temperature creep and strength properties.

Phase II: Provide a pilot plant scale up of process to produce material for characterization, evaluation, and to determine ultimate manufacturing costs.

SB92-029 TITLE: Nonlinear Dynamics Applied to Signal Processing and Innovative Coding Schemes

CATEGORY: Exploratory Development

OBJECTIVE: Investigate the application of techniques from nonlinear dynamics to noise reduction in signal processing and to development of secure coding schemes for communications.

DESCRIPTION: Nonlinear dynamics offers a novel approach to signal processing which may lead to significant capability in noise reduction with computational efficiency. Chaotic dynamics may also offer means for establishing efficient methods for secure communications systems when coupled with other techniques. Te goal of this topic is to investigate these applications in a realistic environment of interest to Department of Defense (DoD).

Phase I: Develop an approach to noise reduction in signal processing using nonlinear dynamics targeted at a specific problem of interest to DoD; or investigate techniques for secure communications which use nonlinear dynamics as part of the scheme.

Phase II: Implement methods investigated in Phase I and demonstrate on target application.

SB92-030 TITLE: Compressive Surface Strengthening of Pressure Dandified Structural Ceramics

CATEGORY: Exploratory Development

OBJECTIVE: Evaluate methods to increase the bend strength of pressure dandified structural ceramics utilizing surface compressive stresses.

DESCRIPTION: Pressure densification of structural ceramics can result in materials with extremely small volume flaws such that bend strength fracture origins are related to surface defects. Significant enhancement of bend strength is expected for this class of ceramics if compressive stresses sufficient to prevent growth of surface flaws is applied. This approach combined with post machining heat treatments to heal surface flaws should result in significant enhancement of useful strength. The proposals should identify the method for generating surface compressive stresses, the effect of temperature and pressure on the surface compressive stress, the stress profile resulting from the compressive strengthening method chosen for evaluation, and an estimate of the magnitude of the strength increase to be expected. Surface strengthening mechanisms which continue to operate at high temperature and can be used with components having complex geometries are of greatest interest.

Phase I: Produce samples with surface compressive stresses which can be evaluated in four point bending, using a standard military specification bend bar test. Commercially available material may be used if compatible with the proposed surface compressive stress strengthening mechanisms proposed. Samples with optimized strengthening will be evaluated for surface flaw sensitivity using controlled flaw techniques.

Phase II: Components of interest to DoD with significant surface stresses in use will be identified, fabricated and evaluated to demonstrate the capability and utility of the surface compressive strengthening method chosen.

SB92-031 TITLE: Concurrent Engineering Technology

CATEGORY: Exploratory Development

OBJECTIVE: Explore new ideas for technology that will enable concurrent engineering of Defense products and systems for the purpose of greatly reducing cost and increasing quality.

DESCRIPTION: The term Concurrent Engineering connotes the integrated, concurrent design of products and their related processes, included manufacturing and support. There are numerous programs within the DoD and industry concerned with the development and promotion of methodologies, tools, organizational structure, and cultures for CE. By contrast, this SBIR offering is more restricted in scope in that its primary objective is to identify and develop new technologies which enable concurrent engineering by DoD producers. Enabling technologies may include those for enhanced information sharing/comparing, automated management of requirements and constraints, integration of dissimilar automated design tools, and multimedia communication.

Phase I: Conceptual formulation and study of validity and utility.

Phase II: Demonstration of feasibility and key features.

SB92-032 TITLE: Electron Beam Processing

CATEGORY: Exploratory Development

OBJECTIVE: Explore the potential of high energy electron beam for material processing.

DESCRIPTION: High energy electron beam offers the potential for processing materials in full density or near full density air. Processing that may benefit from this technique are: metal matrix composite bonding, polymer cross linking, joining ceramics, surface strengthening, and others. A comprehensive study is needed to compare the

advantages of high energy electron beam processing with conventional and unconventional methods like lasers, microwave, plasma and low energy electron beam processing with conventional and unconventional methods like lasers, microwave, plasma and low energy electron beam material processing. A proof of principle experiment may follow pending on the outcome of this study.

Phase I: Produce a comprehensive study comparing the advantages of high energy electron beam processing with other methods.

Phase II: Produce a proof of principle experiment to demonstrate the advantage of this technique.

SB92-033 TITLE: Flexible Manufacturing Process Development for Ceramics and/or Ceramic Fiber Composites

CATEGORY: Exploratory Development

OBJECTIVE: Develop a flexible manufacturing process for advanced ceramics and/or ceramic fiber composites components.

DESCRIPTION: Advanced ceramics and composites are enabling or enhancing technology for DoD systems. Many of the applications where the benefits of these materials can be realized are relatively small volume applications. High tooling costs associated with near net shape forming methods for these small volume applications, result in significant cost disadvantages for these materials. Proposals are sought identifying novel manufacturing methods for advanced ceramics and/or ceramic fiber ceramic matrix composites. Proposal manufacturing processes should: be generally applicable to a large variety of composites; be capable of producing components with small flaw sizes and high weibul modulus; and exhibit low manufacturing costs at small production volumes.

Phase I: Bench scale demonstration of novel flexible manufacturing process for state of the art ceramic and ceramic fiber ceramic matrix composite components.

Phase II: Design and construction of prototype manufacturing equipment and demonstration of its utility in producing a component of interest to DoD.

SB92-034 TITLE: Innovative Laser Crystal Growth Methods

CATEGORY: Exploratory Development

OBJECTIVE: Growth of large Nd:Host laser crystals with reduced surface damage.

DESCRIPTION: Advances in the diode pumping of Nd:Host lasers upon up the possibility of high average power operation. At present the Nd;Host crystals are limited in size and material damage, as well as amplified spontaneous emission and parasitics are limiting factors for high average pore operation. The goal of this program is to develop innovative laser crystal growth methods. Growth of large damage resistant Nd:Host laser crystals for extraction of maximum energy density, while suppressing ASE and parasitics, permits the scaling of solid state lasers to high average powers.

Phase I: Develop concepts and proof of principle experiments to grow large damage resistant Nd;Host laser crystals.

Phase II: Demonstrate growth of large damage resistant Nd:Host laser crystals.

SB92-035 TITLE: Laser Underwater Imaging

CATEGORY: Exploratory Development

OBJECTIVE: Remotely measure and map the optical characteristics of sea water in localized areas, within the field of regard for laser underwater imaging applications.

DESCRIPTION: Laser underwater imaging of objects below the sea water, including open oceans, coastal waters and harbors, is complicated by the optical characteristics absorption and scattering of light. The absorption and scattering of light in sea water is dominated by the various dissolved substances and organic/inorganic matter. The types and concentrations of these particles and dissolved substances vary in time and space, giving rise to non uniform absorption and scattering characteristics. The goal of this program is to remotely measure and map the optical characteristics of sea water in localizes areas, within the field of regard for laser underwater imaging applications.

Phase I: develop concepts and techniques to remotely measure optical scattering and absorption of sea water.

Phase II: Laboratory demonstration of concepts and techniques developed in Phase I to measure optical scattering and absorption of sea water for laser underwater imaging applications.

SB92-036 TITLE: Materials for Molecular Devices

CATEGORY: Exploratory Development

OBJECTIVE: Produce and incorporate novel materials in the construction of an operational molecular scale device.

DESCRIPTION: Devices constructed by the assembly of individual molecular components upward, rather than from the bulk material downward, offer great promise for size and power reduction, along with increased operational speed of the device. Novel synthetic methodologies are sought for the preparation of materials and actual construction of elements such as molecular wires, switches, nanosensors, and storage devices. Other issues, such as the dynamics of molecular scale structures, stability of the molecules, and how devices of molecular dimension are accessed and driven, should also be addressed in the proposal.

Phase I: Identify and synthesize materials and fabricate a molecular scale device.

Phase II: Test the performance of the molecular scale device and demonstrate cost effective application.

SB92-037 TITLE: Novel Concepts to Negate Missile Guidance Electronics

CATEGORY: Exploratory Development

OBJECTIVE: Develop and demonstrate novel concepts to negate missile guidance electronics.

DESCRIPTION: The goal of this program is to develop and demonstrate novel concepts to negate missile guidance electronics and prevent the missile from reaching the target. The concepts shall be applicable to electro optical/infrared and millimeter wave guided missiles at ranges of several kilometers. This new technology must be compatible with deployment on numerous military platforms including fixed and rotary wing aircraft, tanks and other ground vehicles. Expendable jammers, which are being developed in separate programs, will not be considered in this program.

Phase I: Provide an engineering design of portable brass board system.

Phase II: Fabricate portable brass board and test in laboratory.

SB92-038 TITLE: Novel Methods for Control of Industrial Processes

CATEGORY: Exploratory Development

OBJECTIVE: Develop control theoretical methods and software amenable to complicated manufacturing environments of interest to DoD.

DESCRIPTION: Recent advances in control enable use of design methods to amenable to optimization techniques which incorporate engineering constraints directly into the objective. Such techniques should lead to software for a general class of multi input multi output systems. Furthermore, such techniques should be demonstrated on specific manufacturing or industrial processes of interest to DoD.

Phase I: Develop novel methods for controller design which incorporate practical engineering constraints directly into computer aided controller design. Select a manufacturing or industrial processes of interest to DoD.

Phase I: Develop novel methods for controller designs which incorporate practical engineering constraints directly into computer aided controller design. Select a manufacturing process of interest to DoD to serve as a target application of these methods.

Phase II: Develop software design tools and demonstrate efficacy on selected manufacturing process.

SB92-039 TITLE: Novel Li-Anodes for Solid State Batteries

CATEGORY: Exploratory Development

OBJECTIVE: Demonstrate novel Li-alloy anodes or Li-intercalation anodes for the production of high energy/power density, all solid state batteries.

DESCRIPTION: The DARPA Electrochemical Power Sources program is investigating the production of a rechargeable, high energy/power density, all solid state battery, based on the lithium/polymer electrolyte/insertion cathode concept. Novel Li-alloy anodes or Li-intercalation anodes are sought which might lead to an increase in the safety and cycle life of these novel batteries. Chemical compatibility, processibility, and electrochemical stability with the electrolyte are all important considerations. Approaches that integrate a fundamental understanding of ion mobility in solid electrolytes with the design, fabrication, and evaluation of these materials will receive serious consideration.

Phase I: Develop and test promising candidate Li-alloy anodes and/or Li-intercalation anodes.

Phase II: Incorporate the candidates from the Phase I program into an experimental battery and test its performance.

SB92-040 TITLE: Novel, High Efficiency Deposition Processes for Multilayer laminate Structures

CATEGORY: Exploratory Development

OBJECTIVE: Develop and demonstrate novel, cost effective deposition processes for manufacture of multilayer laminate structures.

DESCRIPTION: A significant limitation to widespread application of advanced fiber reinforced composite materials is the high cost of manufacture. Multilayer laminate structures may offer an effective solution to this problem by incorporating the manufacture of composite reinforcement with matrix consolidation in a single apparatus. To achieve cost effective manufacture of multilayer laminate composites, materials deposition processes with high material conversion efficiencies, high deposition rates, broad range of deposition processes with high material conversion efficiencies, high deposition rates, broad range of deposition temperatures, and large area capabilities are required. These process characteristics may potentially be developed by adaptation of current commercial thin film or metallurgical coating processes or by development of entirely new processes.

Phase I: Identify processes, develop manufacturing cost models, identify scale up and automation issues, and demonstrate process feasibility by deposition of a variety of alloy and ceramic materials over a broad temperature range with consistent lamina thickness, composition, and microstructure.

Phase II: Refine and optimize mechanical properties of multilayer laminate structures through control of metal and ceramic compositions, microstructures, interface bonding, thickness, etc. Produce and test specimens and update manufacturing cost model.

SB92-041 TITLE: Optical Memory Storage Materials and Device Concepts

CATEGORY: Exploratory Development

OBJECTIVE: Develop and demonstrate materials and device concepts for optical data storage and retrieval.

DESCRIPTION: The ability to store and retrieve large numbers of data in memory systems is useful for new types of ultra-fast computers. In optical memory systems data can be stored in three dimensions and retrieved very fast. Optical memory systems enable many processors to work in parallel. The capability to store and retrieve an entire image very fast can allow video display of the image more easily. The goal of this program is to develop materials for optical storage and data retrieval methods without cross talk between channels.

Phase I: Identify and characterize materials for three dimensional optical data storage.

Phase II: Laboratory demonstration of: optical data storage in materials identified in Phase I, and data retrieval methods without cross talk between channels.

SB92-042 TITLE: Quantum Devices for Optical Communication and Switching

CATEGORY: Exploratory Development

OBJECTIVE: Develop new ideas in fiber optic communications in both local network and long haul applications.

DESCRIPTION: Long haul fiber optical communications is presently limited by loss and dispersion. Recent advances of erbium-doped fiber amplifier and solutions offer great promise in overcoming these obstacles and provide hope for an all optical communication system. One of the remaining concerns is the signal to noise degradation at detection and amplification. Another concern is the switching speed which may be 1000 G bits/second. Innovative ideas for improved signal to noise amplifiers and ultra fast switching for all optical communication are sought in this solicitation.

Phase I: Produce analysis and design studies of amplifier and/or switching for optical communication.

Phase II: Produce a proof of principle experiment to demonstrate the key features.

SB92-043 TITLE: Rare-earth Doped Fiber Amplifiers

CATEGORY: Exploratory Development

OBJECTIVE: Develop rare-earth doped fiber amplifiers for transmitters and receivers.

DESCRIPTION: Advances in diode pumping of rare earth doped laser materials opens up the possibility of numerous military, scientific and medical applications. The objective of this program is to explore rare-earth doped fiber amplifiers similar to erbium doped fiber amplifiers, for use as power amplifier for transmitters and preamplifier for receivers. This program will address the spectroscopic studies, as well as signal amplification characteristics in rare-earth doped fiber amplifiers.

Phase I: A comprehensive review, analysis and spectroscopic study of diode pumped rare-earth doped fibers.

Phase II: Based on results of Phase I study, perform a proof of principle experiment to demonstrate the feasibility of rare earth doped fiber amplifiers.

SB92-044 TITLE: Sensors for Intelligent Processing of Materials

CATEGORY: Exploratory Development

OBJECTIVE: Develop in-situ sensing techniques for measuring key process parameters which can be used for feedback control of thin film and metallurgical coating processes.

DESCRIPTION: Metallurgical and ceramic coatings manufactured by chemical vapor deposition or physical vapor deposition processes are frequently characterized by a wide variability in thickness, composition, or microstructure. These attributes are often critical to the functional performance of these coatings, and reduction in variation can result in significant improvement in coating life or functionality.

Phase I: Identify and demonstrate feasibility of cost effective sensing concepts for in situ measurement of coating thickness, composition, or microstructure.

Phase II: Incorporate successful sensing technology into a coating manufacturing process to achieve feedback process control.

SB92-045 TITLE: Smart Materials and Structures

CATEGORY: Exploratory Development

OBJECTIVE: Develop and demonstrate a new class of materials which have the capability to both sense and respond to environmental stimuli and which have the capability of active control of their response.

DESCRIPTION: Smart materials offer many enhancements and new capabilities to DoD systems, particularly in performance, durability and reliability. Smart materials can provide designers and engineers with significant new capability to control geometric shape, structure movement, damping and vibration absorption, and other attributes as designed properties of the material. The proposed program should provide for the development of new materials with active constituents. These materials can be designed to react to external stimuli on either a micro mechanical or macro mechanical level. These materials can be designed to react to external stimuli on either a micro mechanical or macro mechanical level. The development of functional adaptive materials along with advances in theory, sensors, actuators, control algorithms and signal processing as applied to smart materials of interest.

Phase I: This effort is concerned with basic theory and proof of concept in the areas of sensors, actuators, composite design, matrix and reinforcement selection, information management and architecture, and control systems as applied to an integrated smart material or as individual topics which have potential applicability to smart materials.

Phase II: Smart materials and structures characterization, calibration and validation.

SB92-046 TITLE: Structural Ceramics Enabling Demonstration

CATEGORY: Advanced Development

OBJECTIVE: Demonstrate the utility of advanced state-of-the-art structural ceramics in military significant and technically demanding systems.

DESCRIPTION: Ceramics offer advantages in strength, elastic modules, wear and corrosion resistance, reduced weight, durability in extreme environments, and in elevated temperature use. Thus the application of ceramics in certain military systems offers potential improvements in the performance of these systems. The proposal should identify cost effective ways to significantly increase the capabilities of DoD systems through the infusion of advanced state-of-the-art structural ceramics into fielded weapon systems or platforms. The demonstration should use commercially available materials in any application with military utility. A design methodology appropriate to ceramics must be employed.

Phase I: Evaluate the performance enhancement potential and/or cost savings to systems in which the demonstration component would be used. Design the component to be used in the demonstration for optimum performance and reliability.

Phase II: Produce the component designed in Phase I and conduct evaluation tests to evaluate component reliability and system performance.

SB92-047 TITLE: Lasers in Supercritical Fluid Processing

CATEGORY: Exploratory Development

OBJECTIVE: Investigate the utility of combining laser irradiation with supercritical fluid processing to provide novel capabilities for materials processing or extraction.

DESCRIPTION: The separation and processing of materials using supercritical fluids are two developed technologies. It is well known that the properties of the supercritical fluid media are both heat and pressure sensitive. Proposals are sought to investigate the utility of laser irradiating the supercritical fluid media to locally and/or globally vary the temperature and/or pressure to enhance supercritical fluid processing. The interaction of the laser radiation with the supercritical fluid media and its detailed effects, along with potential viable applications should be addressed in the proposal.

Phase I: Identify and demonstrate the feasibility of using laser radiation in supercritical fluids to enhance processing.

Phase II: Test the performance of this enhanced processing technique on a specific viable application.

SB92-048 TITLE: Compact High Power Ultra Wide band Radio Frequency Sources

CATEGORY: Exploratory Development

OBJECTIVE: Explore new ideas in UWB RF generation for military applications.

DESCRIPTION: UWB RF sources may offer potential new DoD applications. Numerous ideas have been examined for generating the RF; for example, photo conductive switches, spark gaps, and electron beam switches. But at present, none of these can satisfy simultaneously the requirements of power, pulse repetition rate, life time and size. Innovative ideas are needed, other than the three classes of switches mentioned above, to arrive at a device that can satisfy all these requirements.

Phase I: Provide detailed design studies of the system.

Phase II: Perform a proof of principle experiment.

SB92-049 TITLE: Wavelets and Failure Prediction

CATEGORY: Exploratory Development

OBJECTIVE: Investigate utility of wavelet techniques in detecting and predicting failure in complex mechanical systems.

DESCRIPTION: Wavelets provide a novel class of methods in signal processing for detecting and analyzing transient signals and for extraction of features from broadband signals. Certain physical systems may exhibit behavior which acts as a precursor to failure. Appropriate sensors may provide data which, when analyzed using wavelet methods, could yield precursors to predict failure. This information could be used as part of an automated maintenance information system. Methods for predicting failure would be especially useful for high maintenance items in DoD systems.

Phase I: Develop methods for analyzing and predicting failure based on signal processing methods using wavelet techniques. Work should be targeted to a specific system of interest to DoD which is likely to exhibit precursor behavior.

Phase II: Having developed the techniques, develop and apply software to real data to demonstrate efficacy of the methods.

SB92-050 TITLE: Conformal Electronics Packaging

CATEGORY: Basic Research/Exploratory Development

OBJECTIVE: Develop processes and device concepts for conformal electronic packages.

DESCRIPTION: Concepts for processes and devices are sought for conformal electronic packages. Conventional electronic packaging is concerned with shrinking the volume of electronics. Conformal electronics packaging is concerned with making electronic packages that allow electronics to be put in odd shaped systems. The eventual goal is to be able to intermingle computation, sensors and actuators, and mechanical structure.

Phase I: Develop conformal electronic package concepts. Perform preliminary analysis or experimentation of processes and device concepts.

Phase II: Fabricate conformal electronic package test structures and measure electrical/mechanical performance.

SB92-051 TITLE: Chip on Glass Technology

CATEGORY: Exploratory Development

OBJECTIVE: Develop and test novel techniques of placing chips on glass for the purpose of improving large area, liquid crystal display electronic driver capability.

DESCRIPTION: Increasing liquid crystal panel sizes and resolutions requires driver electronics to be placed closer to the display pixels to minimize power requirements and increase speed. Novel approaches to placing driver circuitry on glass that exhibit low cost and high reliability are sought.

Phase I: Investigate alternative chip on glass packaging approaches that optimize features such as pitch, bonding, interconnection, coefficients of thermal expansion, dielectric constants, cost and reliability. Provide a detailed description of the proposed improved concepts and make recommendations for a production worth chip on glass technology.

Phase II: Build and test a chip on glass breadboard to demonstrate the production capability of the recommended technology.

SB92-052 TITLE: Contrast Enhancement for Electroluminescent Displays

CATEGORY: Exploratory Development

OBJECTIVE: Develop and test novel techniques for increasing the contrast between on and off pixels in Thin Film Electroluminescent (TFEL) Displays.

DESCRIPTION: Concepts are sought for improving the contrast between on and off pixels in TFEL displays. Techniques to reduce light output from off pixels due to reflection of ambient light and/or to increase light output from on pixels should be investigated.

Phase I: Provide a detailed description of the proposed concepts, together with a detailed plan for incorporating these concepts into current TFEL manufacturing techniques.

Phase II: Manufacture a small TFEL improved contrast panel, and deliver to the Defense Advanced Research Projects Agency (DARPA) for evaluation.

SB92-053 TITLE: High Efficiency Polarizers

CATEGORY: Exploratory Development

OBJECTIVE: Evaluate methods to increase efficiency/brightness of Active Matrix Liquid Crystal Displays.

DESCRIPTION: AMLCDs require polarizers to produce the image. These polarizers are a significant source of light loss sin the optical path. High efficiency would increase the brightness of AMLCDs.

Phase I: Identify candidate materials and configurations for high efficiency polarizers.

Phase II: Fabricate and characterize prototype polarizers.

SB92-054 TITLE: Indium Phosphide Material Growth

CATEGORY: Advanced Development

OBJECTIVE: Advance the development and fabrication of InP substrates and epitaxial material for microwave and millimeter wave devices, and monolithic format circuits that will provide performance characteristics not presently available and, thus, satisfy system requirements that are not presently being adequately met.

DESCRIPTION: Gallium arsenide is the most common material that is suitable for use in developing microwave and MMW devices and monolithic format integrated circuits. However, further performance improvements have been achieved using InP as a substrate material, particularly at MMW frequencies. Nevertheless, InP material growth is at an embryonic stage of development and established sources of large diameter InP wafers are not yet available. This project is directed toward the improvement of the microwave and MMW performance characteristics of InP substrate material and substrate/epitaxial combinations. It is expected that this project will also lead to the establishment of sources of supply for large diameter InP wafers with characteristics suitable for high performance and low cost microwave and MMW device and circuit development.

Phase I: Develop a plan for cost effective techniques for producing InP substrate material and/or InP substrate/epitaxial material combinations that will result in a supply of material with performance characteristics suitable for producing microwave and MMW devices and circuits.

Phase II: Perform appropriate work to begin or extend the development of sources of InP substrate material or substrate/epitaxial combinations with the characteristics described above.

SB92-055 TITLE: Indium Phosphide Microwave & Millimeter Wave (MMW) Devices & Circuits

CATEGORY: Advanced Development

OBJECTIVE: Advanced the development and fabrication of InP microwave and MMW devices and monolithic format circuits that will provide performance characteristics not presently available and, thus, satisfy system requirements that are not presently being adequately met.

DESCRIPTION: Gallium arsenide metal semiconductor field effect transistors are being successfully used in a wide range of microwave applications and many MMW applications. However, these devices and the circuits built using them have performance limitations in terms of noise figure, power output and efficiency, particularly at frequencies above 50 GHz. This project is directed toward the present state of the art. Particular emphasis should be placed on developing devices and circuits to meet military system requirements that cannot adequately be met with existing structures.

Phase I: Select one or more InP devices and/or monolithic format circuits that offer the possibility of performance improvements at microwave and MMW frequencies beyond the present state of the art. Develop a plan for the fabrication of the device and/or circuit structures. Consider approaches that will result in the desired structures being produced at the lowest possible cost.

Phase II: Develop final design and fabricate prototype samples of the InP device and circuit structures selected for demonstration. Measure and report upon the microwave or MMW devices and circuits' frequency performance characteristics.

SB92-056 TITLE: Large Area, High Precision Assembly Technology for Displays

CATEGORY: Exploratory Development

OBJECTIVE: Develop and test novel techniques for the mounting and connection of matrix addressed, large area, flat panel displays.

DESCRIPTION: Concepts are sought for improving the reliability and the ease of electrical interconnection or large area, high resolution displays to off glass circuitry. The displays range in size form 10" to 40" diagonal, with resolutions of up to 100 lines per inch.

Phase I: Provide a detailed description of the proposed concepts, together with a detailed plan for incorporating them into Defense Advanced Research Projects Agency (DARPA) provided displays.

Phase II: Utilize these techniques to mount a DARPA provided display, and provide data on the positional accuracy and the reliability of the display.

SB92-057 TITLE: Lightweight, Compact Optics for Head Mounted Displays

CATEGORY: Exploratory Development

OBJECTIVE: Develop and test novel techniques for presenting an image, focused at infinity, to an operator utilizing a head mounted display, and test these techniques utilizing displays provided by the Defense Advanced Research Projects Agency (DARPA) High Definition Systems program.

DESCRIPTION: DARPA has developed high resolution liquid crystal displays and deformable mirror devices which are uniquely suited to generation of images in head mounted displays. Concepts are sought for lightweight, compact optics which will present these images to the operators, allowing for comparison with and overlay to the real world. Both monochrome and color displays are of interest.

Phase I: Provide a detailed description of the proposed concepts, together with a detailed plan for building and testing these devices utilizing DARPA provided displays.

Phase II: Build these HMDs, utilizing displays provided by DARPA, and demonstrate their performance in presenting text, computer generated graphics, and video data.

SB92-058 TITLE: Micro Actuator

CATEGORY: Basic Research/Exploratory Development

OBJECTIVE: Develop materials, processes, and device designs for micro electromechanical valves.

DESCRIPTION: Concepts, materials, processes, and devices are sought for micro-electromechanical valves. In principle, MEM offers numerous advantages for constructing small valves to be used in a variety of systems. MEM devices can be used alone, or distributed systems can be constructed in combination with, for instance, pressure micro sensors and conventional microelectronics.

Phase I: Develop MEM valve concepts. Perform preliminary analysis or experimentation of materials and processes. Explore device concepts.

Phase II: Fabricate MEM valve test structures and measure electrical/mechanical performance.

SB92-059 TITLE: Material and Process Optimization for Color AC Plasma Flat Panel Displays

CATEGORY: Exploratory Development

OBJECTIVE: Evaluate and demonstrate materials and processes to improve the performance of color AC plasma flat panel displays.

DESCRIPTION: Color AC plasma flat panel displays require new and different materials and processes from monochrome displays. Some initial key materials and processes for color displays, such as phosphors, insulators, gas mixtures, and deposition techniques, have been identified. These materials, however, need to be optimized to improve display performance.

Phase I: Identify candidate materials and processes for color AC plasma flat panel displays, develop a rationale for how they improve display performance or manufacture.

Phase II: Incorporate materials or process in display panel.

SB92-060 TITLE: Organic Light Emitting Devices

CATEGORY: Exploratory Development

OBJECTIVE: Investigate and demonstrate emissive displays using organic Light Emitting Devices.

DESCRIPTION: Organic light emitting devices are new materials with a potential for being fabricated into emissive displays. Such devices must have attributes of brightness, efficiency, proper chromaticity, and manufacturability into configurations suitable for display applications.

Phase I: Identify candidate materials for organic light emitting devices for display applications.

Phase II: Fabricate and characterize prototype devices.

SB92-061 TITLE: 3D Electronic Interconnect Technology

CATEGORY: Exploratory Development

OBJECTIVE: Develop 3D techniques for high density packaging of silicon and gallium arsenide high speed logic circuits.

DESCRIPTION: Processes are sought for 3D packaging of silicon and gallium arsenide logic circuits. The full benefit of increased speed of operation of digital integrated circuits will not be realized at the system level unless signal interconnect delays are minimized. With increasing size of 2D multichip modules and consequent lengthening of signal lines, 3D approaches will provide major benefits in density, as well as reducing propagation delays for clock rates of several hundred MHz and higher. Well controlled impedance lines are required to preserve signal integrity. In addition, since power dissipation increases rapidly with clock frequency, innovative approaches are needed to handle high thermal densities.

Phase I: Explore materials and processes for dense 3D electronic packaging of 100 MHz logic circuits.

Phase II: Demonstrate a promising approach to dense 3D electronic packaging of 100 MHz logic circuits through fabrication and measurement of test structures.

SB92-062 TITLE: Radio Frequency Driven Fluorescent Lamps

CATEGORY: Exploratory Development

OBJECTIVE: Evaluate the use of RF driven fluorescent sources in a flat configuration to improve the light output per watt of power input, longevity and ruggedness of flat panel liquid crystal displays.

DESCRIPTION: Flat panel LCD displays need a bright flat backlight. RF driven fluorescent sources in a flat configuration offer the possibility of performance improvement in terms of light output per watt of power input, long life, and enhanced ruggedness due to the lack of electrodes.

Phase I: Identify phosphor materials and gas mixtures appropriate for color LCD flat panels, develop a mechanical design for a backlight, and propose lamp performance specifications.

Phase II: Build and characterize prototype lamp.

SB92-063 TITLE: Uniaxial Materials for Liquid Crystal Display Alignment Layers

CATEGORY: Exploratory Development

OBJECTIVE: Investigate and demonstrate materials and/or processes that will eliminate the need for buffing the polymer layer.

DESCRIPTION: Active matrix liquid crystal displays require a buffed alignment layer to orient the liquid crystal molecules. The buffing process is little understood and a possible source of damage to the display panel during manufacture. Materials and processes are sought that eliminate the need for buffing the polymer layer.
Phase I: Identify candidate materials and methods for producing highly aligned layers.
Phase II: Incorporate the materials or processes in a AMLCD panel.

SB92-064 TITLE: High Reliability Connectors

CATEGORY: Exploratory Development

OBJECTIVE: Develop reliable miniature connectors compatible with high performance electronic multichip modules.

DESCRIPTION: Materials and process technologies are sought to fabricate connectors for digital subsystems with MCMs used in military applications such as work stations, avionics, and smart munitions. Desirable attributes of the connector technology include high reliability, high Input/Output density, good electrical performance up to at least 300 MHz, and preferably several GHz, ease of insertion/removal, ability to withstand multiple reuse, and potential for low cost manufacture.

Phase I: Investigate candidate materials and process technologies, perform preliminary experiments, and develop a plan for fabrication of connectors suitable for high performance MCMs.

Phase II: Select the most promising approach(es), design and fabricate connectors, and perform chemical, electrical, mechanical, and thermal tests.

SB92-065 TITLE: Electronically Controllable Thin Appliqués for Dynamic Alteration of Visual or Thermal Exterior Surface Signatures

CATEGORY: Exploratory Development

OBJECTIVE: Reduce or change visible signature through use of low cost appliqués.

DESCRIPTION: Appliqués for combined or independent control of Infrared and visible signatures are desired. Weights are desired. Reflectance ranges from 0.2 to 0.9 should be achievable, and the ability to add light or heat is desirable. System costs should be less than $10,000 per square meter.

Phase I: Perform a detailed analysis of obtaining appliqués for combined or independent control of IR and visible signatures.

Phase II: Produce a workable system to do the above at a system cost of less than $10,000.

SB92-066 TITLE: Methods for Detection of Guerilla Forces in a Jungle Environment

CATEGORY: Exploratory Development

OBJECTIVE: Detect enemy foot soldiers through dense foliage.

DESCRIPTION: Methods for detecting enemy foot soldiers through dense foliage are desired. Systems should be capable of at least 100 meter detection range, and environmental effects or animals should be avoided. Provision of range and bearing are desirable, but not required.
Phase I: Perform a detailed analysis of a system for detecting enemy foot soldiers through dense foliage with the above criteria.
Phase II: Develop and demonstrate a working system to attain the objective.

SB92-067 TITLE: Sensors or Methods for Airborne Detection and Discrimination of Buried Land Mines

CATEGORY: Exploratory Development

OBJECTIVE: Rapid detection of minefields to support swift moving offensive operations.

DESCRIPTION: Sensors are desired for detection of buried and surface minefields from altitudes of 100 feet and higher. Discrimination of mines from other clutter objects is a must. Sweep rates of at least 30 knots and 100 meter scan widths should be attainable. At least 50 percent of all mines should be detected to assure detection of the minefield.

Phase I: Perform analysis of proposed approach to attain sweep rates of at least 30 knots and 100 meter scan widths with at least 50 percent detection rate of mines.

Phase II: In collaboration with end users, build a working prototype.

SB92-068 TITLE: Circuit Architectures that Employ only Nearest Neighbor and Next Nearest Neighbor Connections

CATEGORY: Exploratory Development

OBJECTIVE: Explore the utility of circuit configurations that are limited in their drive capability to only nearest neighbor and next nearest neighbor connections for general purpose computing.

DESCRIPTION: While there are numerous specialty applications that require only short interconnects between components, it is not clear what limitations a restriction to only nearest neighbor and next nearest neighbor interconnects would have on general purpose computers. As device dimensions progressively shrink to ever smaller dimensions, the need to drive long interconnects limits the usefulness of continued device scaling. It is the intent of this effort to seek innovative solutions to general purpose computing architectures that would suffer the least penalty from the limited drive capability of ultra small devices and to identify the penalties associated with such architectures.

Phase I: Design a general purpose computing architecture that requires only nearest neighbor and next nearest neighbor connections. Analyze its performance and identify limitations.

Phase II: Demonstrate the performance of architectures that appear promising by fabricating and testing critical portions of the design on large gate arrays.

SB92-069 TITLE: Architectures that Employ Real Time, Reconfigurable Interconnections

CATEGORY: Exploratory Development

OBJECTIVE: Explore architectures that will take advantage of the ability to reconfigure interconnects in real time.

DESCRIPTION: With holography providing the ability to reconfigure free space optical interconnects in real time, it becomes important to explore what new capability in signal and data processing can result from this new degree of freedom. This solicitation seeks architectural ideas that promise to provide substantial performance advantage in speed, power and/or component count by utilizing real time, reconfigurable interconnections.

Phase I: Identify and design architectural building blocks that take advantage of real time, reconfigurable interconnections.

Phase II: Demonstrate the advantages of the identified architectural building blocks by building a simulation and/or hardware implementation.

SB92-070 TITLE: Circuits that Employ Resonant Tunnel Diodes/Transistors

CATEGORY: Exploratory Development

OBJECTIVE: Explore circuit concepts that take advantage of the unique characteristics of resonant tunnel diodes and/or transistors to improve with or without other integrated circuit components to attain improved performance.

DESCRIPTION: The Defense Advanced Research Projects Agency (DARPA) has been instrumental in developing the fabrication technology needed to build resonant tunnel diodes and transistors. State of the art devices have shown highly promising characteristics both at room temperature and cryogenic temperatures. A few circuit applications have already been demonstrated. It is the intent of this solicitation to broaden the areas of application for these devices. Only room temperature operation is of interest at this time. Ideas are sought that promise to demonstrate that resonant tunnel diodes and transistors, with or without other components, can significantly decrease the device count and consequently reduce the chip area, reduce circuit power consumption, or enhance the speed of either important analog or digital custom circuits. Ideas that apply to possible utilization of these devices in gate or cell arrays that project a significant advantage are also of interest.

Phase I: Identify a circuit concept, develop a chip layout and substantiate claimed performance advantages by theoretical calculations, simulations or other commonly accepted means.

Phase II: Fabricate and test the designed circuit.

SB92-071 TITLE: Growth of Bulk II-VI Crystals for Visible Light Emitters

CATEGORY: Exploratory Development

OBJECTIVE: Develop improved techniques for growing II-VI bulk crystals for use in visible light emitting structures.

DESCRIPTION: The Defense Advanced Research Projects Agency (DARPA) is investigating visible light emitting structures for use in optical displays, high density recording, and military communications. Better quality substrates are needed for research and development of II VI semiconductor visible light emitters. Two substrates of great interest are heavily doped p-type zing telluride and heavily doped n-type zinc sellinide. Advances in the growth of these materials are sought which will yield two inch or larger diameter boules of dislocation free semiconductor. Proposed approaches should be capable of growing high quality single crystal material.

Phase I: Identify important process parameters to produce high quality, heavily doped, single crystal, bulk II-VI materials.

Phase II: Implement process for improved growth. Demonstrate improved technique by growing two-inch diameter boules of heavily doped.

SB92-072 TITLE: High Efficiency Blue Light Emitting Diodes

CATEGORY: Advanced Development

OBJECTIVE: Improve light conversion efficiency of blue LEDs.

DESCRIPTION: Blue emitters are of use in optical recording, display, and communications. At present, only available LEDs in the blue area of low efficiency, approximately .1%. This solicitation is to investigate means of improving light conversion efficiency of the LEDs while maintaining long life time, low power consumption, and small size. A realistic goal would be 1% wall plug efficiency.

Phase I: Investigate and demonstrate doping and contact technology to achieve higher light emitting efficiency.

Phase II: Fabricate and package high efficiency blue LEDs.

SB92-073 TITLE: Neural Network Techniques for Practical Applications to Time Series Prediction

CATEGORY: Exploratory Development

OBJECTIVE: Identify, develop and demonstrate neural network techniques for specific applications involving time series predictions.

DESCRIPTION: Neural networks have demonstrated superior performance relative to classical methods for predicting the future behavior of a pseudo random time series. There are many practical applications where such forecasting, even if imperfect and short term, can be of great value. Examples include: adaptively forecasting demand for scarce, high value resources for dynamic resource allocation; forecasting natural phenomena; and compensating feedback delays in control systems. DARPA is interested in bringing neural network forecasting to fruition for specific, high value applications, and in identifying additional research needed to broaden and improve the approach. Proposals must address a specific application, must contain a well defined neural network approach, and must include a plan for practical utilization of the forecasting system developed.

Phase I: Choose a specific application, develop and demonstrate the neural network forecasting system, provide a preliminary comparison with the best competing approaches, and evaluate the practical impact of the system.

Phase II: Perform an in-depth comparison with competing approaches and, if warranted, optimize the design of the neural network forecaster, and develop a plan for installation in a specific system.

SB92-074 TITLE: Neural Network Signal Processing Techniques for Communication Links

CATEGORY: Exploratory Development

OBJECTIVE: Identify, develop, and demonstrate neural network signal processing techniques for improving the performance of communication links.

DESCRIPTION: Many communication systems require adaptive signal processing for optimal link performance. Examples include data and speech compression, extracting signals from non-Gaussian interference, and correcting non-linear distortions. Neural networks are a general technique for adaptive signal processing. DARPA is interested in developing neural network techniques to improve communication system performance. Proposals must address a specific high value application, must contain a well defined neural network approach, and must include a clear rationale for the improvements anticipated from neural network processing.

Phase I: Choose a specific communication link application, develop and demonstrate the neural network signal processing technique, and provide a preliminary comparison with the best competing approaches.

Phase II: Perform an in-depth comparison with competing approaches and, if warranted, optimize the design of the neural network processor, develop and test a brass board hardware implementation, and develop a plan for implementation on a specific platform.

SB92-075 TITLE: Neural Network Signal Processing Techniques for Radar Applications

CATEGORY: Exploratory Development

OBJECTIVE: Identify, develop, and demonstrate neural network signal processing techniques for improving the performance of radar systems.

DESCRIPTION: Many radar systems require adaptive signal processing for optimal performance. Examples include auto-focus compensation for random phase errors, extracting radar signals from clutter, and extracting and tracking designated target types. Neural networks are a general technique for adaptive signal processing. DARPA

is interested in developing neural network techniques to improve radar system performance. Proposals must address a specific high value application, must contain a well defined neural network approach, and must include a clear rationale for the improvements anticipated from neural network processing.

Phase I: Choose a specific radar enhancement application, develop and demonstrate the neural network signal processing technique, and provide a preliminary comparison with the best competing approaches.

Phase II: Perform an in depth comparison with competing approaches and, if warranted, optimize the design of the neural network processor, develop and test a brass board hardware implementation, and develop a plan for implementation on a specific platform.

SB92-076 TITLE: Resists for 193-Nanometer Photolithography

CATEGORY: Exploratory Development

OBJECTIVE: Develop Photo resists for Lithography at the 193-nm Wavelength.

DESCRIPTION: DARPA is developing 193-nm projection lithography systems to enable cost effective fabrication of military application specific integrated circuits with features sizes at or below 0.25 microns. These systems require photo resists which exhibit a sensitivity in the range of 2-50 at the wavelength and are capable of producing cleanly defined patterns. Ideally, these resists must demonstrate feature sizes as small as 0.15 microns with simple processing sequences which are compatible for low cost, high yield very large scale integration circuit fabrication. Currently, several surface imaging silylation resists and bilayer schemes have been identified and initial demonstrated. However, several candidate resists are required to meet process specific manufacturing goals. As examples of the range of sometime conflicting resists requirements, both positive and negate veresists are needed, materials with good dry etch resistance are essential for some process steps, while a single layer resist with lowest processing cost may be desired for other process steps. Having identified candidate resist materials, the development of a manufacturing process capable of producing commercially useful quantities of high quality material is also required. Evaluation of resists should be performed in conjunction with the DARPA 193 nm lithography program; therefore, adequate travel resources should be planned.

Phase I: Provide small quantities of candidate resist materials for evaluation of the 193 nm imaging properties. Demonstrate that the selected resists have the potential to be manufactured in a robust manner and that they have adequate process latitude for semiconductor manufacturing.

Phase II: Scale up production of the most promising material and perform a detailed evaluation of process reproducibility, cost, and yield.

SB92-077 TITLE: Stencil Mask Technology for Ion Beam Lithography

CATEGORY: Advanced Development

OBJECTIVE: Investigate, design and demonstrate novel techniques for the cost effective fabrication of transmission masks to replicate minimum feature sizes of 100 nm.

DESCRIPTION: The performance parameters of microelectronic circuitry can be significantly improved by further downscaling the device dimensions. Lithography is the pacing step for any advance. Ion beam lithography may be a viable alternative for features around the range of 100 nm. The strategy for the present effort is to explore innovative approaches beyond the channeling of protons through a thin crystalline silicon membrane. Both evolutionary and revolutionary advances in mask technology are needed. Quantitative investigation of all aspects of distortion prone techniques is required.

Phase I: Address optimization of mask configuration, demonstration and evaluation of pattern replication at the 50 to 100 nm level.

Phase II: Explore the practical implementation of the results achieved in Phase I through the fabrication of circuitry at 100 to 150 nm feature sizes with relevant overlay accuracy.

SB92-078 TITLE: Dictation System for Tactical Environments

CATEGORY: Exploratory Development

OBJECTIVE: Develop hardware and software for dictating reports under field conditions.

DESCRIPTION: Large vocabulary speech to text dictation systems suitable for office environments are beginning to appear on the market. Similar systems could be useful in tactical environments, where users might be willing to trade perplexity and vocabulary size for robustness under a wider range of acoustic conditions. Nevertheless, users must be free to create text without artificial grammatical constraints, must be able to use new words, and must be able to operate without keyboards. In addition, users should not have to go through length enrollment procedures to train the system to their voices.

Phase I: Develop a prototype system and evaluate its performance under varied acoustic conditions.

Phase II: Improve the system and demonstrate its effectiveness in realistic tests.

SB92-079 TITLE: Discourse Analysis for Text Understanding

CATEGORY: Research

OBJECTIVE: Develop effective techniques for understanding free text discourse.

DESCRIPTION: Researchers are making good progress in developing automated text understanding capabilities, but discourse analysis remains problematic, especially in texts that encompass multiple topics or events. Novel, generic approaches are sought for addressing this key problem.

Phase I: Develop a preliminary version of proposed techniques. Perform a limited proof of concept.

Phase II: Extend and enhance the techniques. Put them into shareable software. Evaluate their performance in a data extraction system operating on a variety of texts.

SB92-080 TITLE: Military Applications of Speech Recognition

CATEGORY: Advanced Development

OBJECTIVE: Demonstrate effective military applications for speech recognition.

DESCRIPTION: Speech recognizers, continually improving and already being used to good effect in the commercial world, could play important roles in a variety of military applications. The challenge here is to find suitable, high payoff applications and then to demonstrate operational effectiveness in some of them. In order to maximize the chances for success, only the most robust recognition technology should be considered, and serious attention must be paid to human factor issues.

Phase I: Identify several high payoff military applications for speech recognition, analyze them carefully, and determine which available recognizers will best meet those needs. Develop detailed plans for developing and testing each of those applications.

Phase II: Develop one or more of those applications by DARPA and demonstrate effectiveness with military users.

SB92-081 TITLE: Networked Micro Computer System for Information Retrieval form Large Text Databases

CATEGORY: Exploratory Development

OBJECTIVE: Explore and evaluate the concept of achieving information retrieval from one or more large scale, unstructured, text databases by distributing the database among a network of micro computers and servicing retrieval requests from client workstations which are also on the network.

DESCRIPTION: One concept for achieving information retrieval from large, unstructured collections of text is to divide the text among a network of microprocessors having individual storage, and to access the data in a distributed manner form client workstations. Evaluation of this concept requires the development of an appropriate network architecture, interface modules and communication protocols. A prototype will be necessary to test this concept and to evaluate the performance of the architecture and system.

Phase I: Provide a detailed specification of the proposed system, including its architecture, computational modules, interface modules, and protocols for communication among the distributed parts of the retrieval system and the client workstations. Prescribe an experimental paradigm for evaluating the efficacy of this concept vis-à-vis other implementations of large scale text retrieval.

Phase II: Implement a prototype of these system and conduct the evaluation, as specified and prescribed in Phase I. Report on details of implementation not covered in the Phase I descriptions and analyze the performance. A copy of the code is to be included in the report. A magnetic media copy of the code is to be delivered in ASCII form, in the UNIX tar format.

SB92-082 TITLE: Robust Speech Parameterization for Channel Independence and Noise/Inference Immunity

CATEGORY: Basic Research

OBJECTIVE: Explore novel ways to parameterize a speech signal so as to provide measurements which maximize speech recognition and/or talker identification scores while minimizing the effects of the channel over which the talker is speaking and the effects of noise and interference.

DESCRIPTION: Concepts are sought for novel signal processing techniques and new approaches to computing distances in speech parameter space which isolate the information bearing elements of the speech signal form noise and interference and which are insensitive to the filtering characteristics of, and to mild distortions cause by, the channel.

Phase I: Provide a conceptual, mathematical, and algorithmic description of the proposed techniques and a discussion of their novelty and advantages over current ones. Design a plan for evaluating the techniques and provide a detailed specification of a system for demonstrating the techniques and for performing the evaluation.

Phase II: Implement the new techniques and the design and evaluation system, and perform the proposed evaluation. Report on details of implementation not covered in the Phase I descriptions, and analyze the performance, particularly the source of errors. A copy of the code is to be included in the report. A magnetic-media copy of the code is to be delivered in ASCII form, in the UNIX tar format.

SB92-083 TITLE: Voice Authentication Monitoring System

CATEGORY: Exploratory Development

OBJECTIVE: Explore novel techniques for monitoring and making decisions about a speech signal to ascertain that the talker is the person he claims to be and that he has not, during the course of the conversation, been replaced by an imposter.

DESCRIPTION: Concepts are sought for novel signal processing and decision making techniques for parametrizing a speaker's voice, computing the change in those parameters both during a conversation and from a baseline set of parameters for the claimed talker, and making a decision as to whether to terminate the conversation or allow it to continue. The techniques must accommodate normal voice changes over time and during a conversation, while being able to recognize that an impostor has either initiated or hijacked the conversation. The decision procedure must be sensitive to speaker change, yet not prematurely terminate valid conversations, as a consequence of repeated testing. It is anticipated that both the selection of an appropriate technique from competing ones, and the determination of operating parameters for a technique, will require empirical evaluation. Therefore, this exploratory development will include the design and implementation of a suitable system for the comparative evaluation of different signal processing and decision making techniques, and the design of a paradigm for making such an evaluation.

Phase I: Provide a conceptual, mathematical and algorithmic description of the proposed techniques and a discussion of their novelty and advantages over current ones. Identify and explain the operational parameters for each technique provide a detailed specification of a system for demonstrating and evaluating the techniques.

Phase II: Implement the system and the techniques and perform test for setting parameters and evaluating performance. Report on details of implementation not covered in the Phase I descriptions, and analyze the performance, particularly the source of errors. A copy of the code is to be included in the report. A magnetic media copy of the code is to be delivered in ASCII form, in the UNIX tar format.

SB92-084 TITLE: Large Scale Surface Velocity/Pressure measurement Techniques

CATEGORY: Exploratory Development

OBJECTIVE: Develop a capability at large scale for measuring high frequency, unsteady surface pressures and velocities over large areas of the hull, appendages, control surfaces, and propulsion components.

DESCRIPTION: DARPA is investigating innovative methods for measuring full scale surface pressures and velocities to provide data for computational fluid dynamics code and maneuvering prediction code validation. Conventional methods for measuring surface pressures have been based on laboratory techniques that depended on discrete points such as pressure taps and pilot tubes. New materials now make it possible to make integrated surface measurements over large areas. DARPA considers that developments in signal multiplexing and miniaturization of area sensors should minimize the installation, power, and data processing roadblocks which would be expected of conventional techniques for large scale implementation.

Phase I: Demonstrate area measurement capability at laboratory scale for proof of concept.

Phase II: Demonstrate salability and provide prototype system for application.

SB92-085 TITLE: Analytical/Numerical Modeling of Target Strength in the Intermediate Frequency Range

CATEGORY: Advanced Development

OBJECTIVE: Develop an analytical/numerical model for calculating target strength in the intermediate frequency range.

DESCRIPTION: Analytical/numerical techniques for modeling target strength in the intermediate frequency range are currently being developed. One approach is to expand the frequency range over which existing TS models

apply. Further research, engineering, and analysis needs to be completed in order to determine the extent to which these current TS models can be used.

Phase I: Identify which TS models can be used in the intermediate frequency range, and the frequency band over which each TS model will provide reasonable results.

Phase II: Demonstrate each model over its expanded frequency range and compare the results with experimental or analytical data.

SB92-086 TITLE: Post Processing Visualization of Acoustic Data

CATEGORY: Exploratory Development

OBJECTIVE: Develop graphics tools to efficiently correlate and interpret experimental radiation and scattering data.

DESCRIPTION: DARPA is investigating innovative graphics tools for use in a Data Simulation/Visualization system for interpreting underwater acoustical data. The data input to the S/V system may be generated either experimentally or analytically. The S/V system will be capable of reconstructing wet surface motions and near field pressures from either wet surface computed velocities and pressures or measured pressures defined on a near field developing surface.

Phase I; Develop efficient procedures for the display of computer near field fluid pressure.

Phase II: Demonstrate the capabilities of the graphics tool developed on representative benchmark problems results.

SB92-087 TITLE: Remote Silent Actuation System

CATEGORY: Exploratory Development

OBJECTIVE: Develop techniques for producing lift by deflecting control surfaces, fins, appendages, tabs, hinge lines, hydro elasticity tailoring the surfaces, or altering the flow using MHD, etc.

DESCRIPTION: DARPA is investigating innovative technologies for compact, remote, and quiet actuation techniques for application to marine control surfaces, particularly for submarines. Current submarine control surfaces are deflected primarily by internally mounted hydraulic cylinders. These cylinders are large castings/forgings welded into the pressure hull, typically located in the end closures. This type of configuration has a significant weight, volume and cost impact on both ship design and construction. DARPA developed concepts for innovative methods of vertical plane control, vorticity management, boundary layer flow control, propulsor inflow and intrapropulsor flows require multiple external control force producers remote from convenient internal pressure hull locations. To effectively utilize these concepts, one must consider methods which will minimize current attachment structure, provide for compact external powering systems and maximize force production efficiencies while providing for low level acoustic radiation.

Phase I: Develop physical models that will provide proof of concept.

Phase II: Develop configuration for salability to full scale application.

SB92-088 TITLE: Underwater Imaging for Small Object Locating and Identification

CATEGORY: Exploratory Development

OBJECTIVE: Develop a conceptual design for an underwater imaging system for use in search, investigation, and exploitation of underwater objects.

DESCRIPTION: The ability to search and inspect large subsurface areas using underwater imaging is desirable for identification and information gathering support. Current systems are low resolution, have limited viewing coverage area, or are not real time capable. DARPA is interested in an underwater imaging system utilizing an illumination system with the ability to reduce backscatter light and non uniform illumination. As envisioned, these system should incorporate image processing functions to deliver high quality video representation, correct image distortion caused by platform motion, and perform image enhancement. Proposed systems should represent truly innovative concepts, and offer the potential for significant improvement in capability.

Phase I: Define system requirements, capabilities, and top level designs.

Phase II: Construct and test a proof of concept demonstrator.

SB92-089 TITLE: Neural Network Technology in Composite Fabrication

CATEGORY: Exploratory Development

OBJECTIVE: Use neural network technology to improve fabrication of thick polymer matrix composites.

DESCRIPTION: DARPA is developing advanced techniques for the cost effective, high rate fabrication of high quality, thick composite materials. This program is pushing the state of the art in manufacturing, quality control, and non destructive evaluation. Neural networks would meet the requirement of advanced monitoring and control systems. The use of neural networks in fabrication would enable the fabrication system to produce quality thick composite products through an optimal process that can be learned, real time, by the system. Neural networks would effectively reduce the amount of time required to develop optimum fabrication processes.

Phase I: Develop system architecture and algorithms required for monitor, control, and evaluation of composite material fabrication.

Phase II: Demonstrate neural network capability in subscale composite structure.

SB92-090 TITLE: Air Driven Power Module

CATEGORY: Exploratory Development

OBJECTIVE: Build and demonstrate a 8.4 Watt and 56 Watt Air Driven Turbo-Alternator.

DESCRIPTION: A critical need exists for a small power module to supply 28 volts DC power. Batteries are used at the present time for this application because connecting power lines are prohibited. Bringing power wires into these sensitive areas would defeat the high voltage insulation, provide a path for lightning strikes, and allow the entry of undesired radio frequency radiation. An insulated air hose is permissible, and could supply air power to a small turbine driving a generator or alternator. One application requires a unit no larger than 2 inches in diameter by 2 inches in length that can supply 300 milliamperes. Another application requires 28 volts DC. This unit can be 2.5 inches in diameter and 3 inches in length. The output of each unit must be regulated. They should be efficient to minimize the air flow required.

Phase I: Provide a suitable design meeting the above requirements and deliver a working prototype together with test data.

Phase II: Improve the prototype designs to increase the efficiency and reduce production costs. Deliver 10 units of each type machine.

SB92-091 TITLE: Automated Testing of Infrared Focal Plane Arrays

CATEGORY: Exploratory Development

OBJECTIVE: Enable the Government to become a smart buyer of the technology of Infrared Focal Plane Arrays by enhancing in house capabilities in diagnostic and prognostics for this technology.

DESCRIPTION: With the emergence of second generation Focal Plane Array technology, high density staring arrays will soon be approaching a half million pixel elements per array. Automation must therefore be an essential element of the prognostic and diagnostic equipment developed under this program. The equipment should be capable of handling the several staring sensor array configurations in the DARPA IRFPA Initiative, and at the same time provide the potential for growth to arrays with larger numbers of elements. For the immediate future, array technology will be based on mercury cadmium telluride, indium antimonide, and platinum silicide.

Phase I: Perform design tradeoff study that takes into account the FPA operability parameters desired, the industry standards for conducting tests, speed of operations and throughput of the instrumentation, the human operator interface, and cost. Two or more designs may be offered at the conclusion of the Phase I effort.

Phase II: Develop and deliver to the government both the hardware and software for the design option selected from Phase I.

SB92-092 TITLE: Common Intelligent Tutoring System Architecture for Application to a Family of Weapon Systems

CATEGORY: Exploratory Development

OBJECTIVE: Develop an intelligent tutoring system (ITS) architecture that is flexible, modular structured, and can be efficiently used in a family of tactical weapon systems embedded training operations.

DESCRIPTION: Functional operation of an ITS includes: presenting a knowledge and/or skill task to the student; comparing action of the student with a knowledge based expert solution; analyzing the difference in student/expert response; generating a corrective knowledge skill task; selecting an appropriate tutoring strategy for the particular student; tutoring the student with the new task; and comparing student/expert action. This process is continuous until the student's deficiencies in knowledge and skills are corrected or the student achieves a predetermined level of proficiency. ITS operation used in the context of embedded training in tactical weapon systems can enhance weapon system performance by maintaining critical skill at the highest proficiency levels.

Phase I: Select an example family of weapon systems and evaluate a basic subset of system operation that could be enhanced with embedded operator training. Conduct an analysis on the subset of weapon systems with operator critical skill requirements for operating in a battlefield environment. Design, develop and implement a preliminary functional prototype of the ITS architecture.

Phase II: Develop, implement and demonstrate with appropriate simulations, and deliver to the government, the implemented modular ITS architecture. The ITS operation will support the candidate subset of weapons embedded training operations.

SB92-093 TITLE: Composite Material Wet-Braiding Fabrication Technology Development

CATEGORY: Exploratory Development

OBJECTIVE: Evaluate rocket motor component fabrication utilizing wet braiding methods and braided component response to insensitive munitions requirements.

DESCRIPTION: Composite materials have the potential to meet or exceed the requirements associated with the IM policies, such as bullet, fragment and shape charge jet impacts and fast/slow cook off thermal environments as defined in MIL STD. To date, most work in composite materials fabrication has been in the area of filament winding. This project would examine composite material fabrication by wet braiding. Proposed concepts should be applicable of ruse with a 144 courier wardwell braiding machine. Specific areas of interest include; hybrid materials; end closures; design prediction, analysis and verification; and machine/computer interface with sufficient accuracy to braid design.

Phase I: Develop braid machine/computer interface and design software concepts.

Phase II: Fabricate and test a proof of principle tactical rocket motor case.

SB92-094 TITLE: Development of a Compact, Minimum Noise, Auxiliary Power Unit for Lightweight Vehicles

CATEGORY: Advanced Development

OBJECTIVE: Advanced the development of a compact, 3 Phase APU for lightweight vehicles.

DESCRIPTION: Army concepts currently under the development utilize subsystems with 3 Phase AC power requirements greater than 30 kilowatts. Currently, such devices are not available in industry to meet these criteria and fit into lightweight vehicles such as the Highly Mobile Multi-Wheeled Vehicle. This development addresses the efforts to lighten the force while allowing the introduction of emerging technology systems. A typical example of such an APU would be a 20" w x 18" h x 42"1 package operating at 400Hz, producing 30Kw of 3 Phase AC power.

Phase I: Show through preliminary designs how powers of up to 60Kw could be delivered in minimal package sizes. Select an approach to proposed hardware and provide realistic final designs for a 30Kw unit suitable for assembly in a Phase II effort. Provide a demonstration brass board of a 30 Kw unit for evaluation.

Phase II: Fabricate and deliver one 30 Kw unit and one 60 Kw unit fully optimized to integrate into the HMMWV.

SB92-095 TITLE: Earth Penetrating Radar

CATEGORY: Exploratory Development

OBJECTIVE: Demonstrate the capability of detecting buried assets such as tanks, mobile missile launchers, Armored Personnel Carriers, mines, etc.

DESCRIPTION: Show the feasibility of using low frequency radar to detect the presence of tanks, artillery pieces, and APCs under various depths and types of soils. Also, investigate the feasibility of detecting underground bunkers, tunnels, and the possibility of detection and differentiation of decoys from real targets.

Phase I: Design trade-off studies that will select the optimum method to solve the problem within the unique parameters and constraints presented by this effort.

Phase II: Construct a system that can be tested and evaluated under actual field conditions against buried assets.

SB92-096 TITLE: Feature based Design Methods for Predictive Design Paradigms

CATEGORY: Exploratory Development

OBJECTIVE: Investigate, develop and demonstrate innovative techniques which utilize feature based design methodologies in a conceptual design process which is predictive of producibility and manufacturability considerations.

DESCRIPTION: Emerging technologies in Artificial Intelligence/expert systems have shown great promise as tools for evaluation of conceptual designs for producibility and manufacturability considerations. However, conventional Computer Aided Design technologies have not demonstrated the capability to adequately capture and manage the design intent knowledge necessary to allow for prediction of subsequent producibility considerations. Feature based design theory and preliminary efforts have shown the potential for providing a fundamental method for predictive designs.

Phase I: Identify and demonstrate innovative feature based design methodologies which capture and manage design intent knowledge as a fundamental predictive design model.

Phase II: Develop a feature based design system which captures and manages the predictive design as a knowledge base suitable for manipulation by a producibility expert system.

SB92-097 TITLE: High Power Laser Pumping of Solid State Lasers

CATEGORY: Exploratory Development

OBJECTIVE: Demonstrate and develop efficient, compact, tunable, high power, solid state laser devices operating in the Infrared and blue/green spectral regions.

DESCRIPTION: Many interesting laser applications involving remote locations of the laser systems, atmospheric transmission, and/or narrow band width, tunable laser beams would be made feasible or significantly enhanced if compact, lightweight, tunable and single frequency, solid state lasers at much higher average power levels than now available could be developed. The demonstration of the feasibility of solid state laser systems with average power levels of greater than 100 watts is the goal of this program. One approach is this goal is the use of short wavelength chemical lasers. SWCLs of the type now being developed will: operate in the 450 to 550 nm spectral range; not require an electrical power supply system; have a relatively high chemical efficiency; and be compact and lightweight. In addition, SWCLs will operate at power levels up to several kilowatts, so that solid state components and not the pump lasers will limit the high power potential of such systems.

Phase I: Conduct a study of the demonstration and development of new SWCL concepts with performance characteristics attractive for use as pump lasers in high power, tunable, solid state laser systems and on the synthesis and evaluation of solid state laser systems that incorporate demonstrated SWCLs as the pump lasers.

Phase II: Conduct an experimental program to determine the feasibility and optimized performance characteristics of one or more new SWCL concepts at the power level needed in advanced solid state laser systems. One or more breadboard laser devices using existing SWCL pumps will be experimentally evaluated in view of requirements of key applications.

SB92-098 TITLE: High Speed Electrodes for High Density Optical Guided Wave Devices

CATEGORY: Exploratory Development

OBJECTIVE: Develop high speed electrode structures suitable for Electro optical devices on guided wave substrates with high packing density and minimum degradation to device performance.

DESCRIPTION: High speed linear guided wave electro optical devices have been demonstrated using traveling wave electrode structures operating in the 10-25 GHz range using EO materials. However, these devices generally consist of one or only a small number of devices on a substrate. In order to increase the packing density, issues such

as electrical and optical isolation as well as interconnects must be considered. This may include the development of new optical structures in support of improved device electrodes.

Phase I: Design and develop optical and electrode structures for multiple element devices which optimize performance and isolation at frequencies in the range of 1-30 GHz. Determine performance limitations and trade-offs. Perform a device demonstration for design verification.

Phase II: Develop and demonstrate high density device designs for specialized EO components. Optimize designs for performance trade-offs and comparisons.

SB92-099 TITLE: High Speed Image Capture for Fiber Optics Payout Applications

CATEGORY: Basic Research

OBJECTIVE: Expand video and photographic data collection capabilities in order to gain an understanding of payout dynamics and validate payout dynamics models. It is necessary to determine adhesive rupture characteristic under high strain rates, fiber peel point, takeoff angle geometries, and helix geometry.

DESCRIPTION: In order to reduce costs and improve reliability of fiber optics payout through modeling, it is necessary to determine the values for the input parameters of the models. It has been observed that fiber shape at the peel point varies from the predicted steady state shape. One possible cause may be that the adhesive rupture force under high strain rates differs greatly from the slow pull rate force. The roles played by friction and electrostatic buildup in high speed payout are also unclear. The effects of varying aerodynamic conditions on the helix geometry and the subsequent effects on the peel point area are undetermined. Therefore, it is necessary to collect data which will lead to an understanding of the conditions prevailing in high speed payout.

Phase I: Determine the most feasible method for obtaining adhesive rupture characterization data and fiber geometry data during high speed payout. Specifically, determine the feasibility, limitations, and hardware availability for visual data collection systems, including system which could be developed using government furnished equipment.

Phase II: Develop and test camera systems found to be most feasible for collecting data that could lead to the determination of adhesive break patterns and fiber geometry during high speed payout. Also, develop a video system to collect fiber peel point data simultaneously in tow planes and provide for data reduction and correlation techniques for the collected data.

SB92-100 TITLE: Identification Friend or Foe System for Ground Vehicles

CATEGORY: Exploratory Development

OBJECTIVE: Demonstrate a system for providing identification of friendly ground forces to aircraft and other ground forces.

DESCRIPTION: High performance aircraft attacking enemy ground vehicles lack the means of insuring the vehicles are not friendly. The result is that friendly forces are occasionally damaged or destroyed. A system providing positive identification of friendly forces to the pilot must be extremely reliable. A vehicle with a failed IFF would be presumed enemy and would be attacked. It must be nearly impossible for the enemy to counterfeit the IFF device or use captured devices for more than 24 hours to protect themselves from attacking aircraft. The system must operate in all weather conditions that permit attack of vehicles. The IFF device must be passive until interrogated by a proper code from the attack vehicle. The system must be completely automatic and require no crew action other than possibly entering a new code. Finally, the IFF system must be safeguarded to keep the enemy from teasing the IFF into revealing the code by covertly interrogating the IFF device with all possible interrogation codes.

Phase I: Make a study for an IFF system meeting the stated requirements. Describe operating details and make performance analysis. Provide sufficient field tests to assure that the signal to noise for the system proposed will be adequate.

Phase II: Develop and deliver two working IFF systems. Each system must consist of the interrogating and the responding units. Include with each system, operating instructions, schematics, parts lists, and trouble shooting guides.

SB92-101 TITLE: Infrared Signal Combining Techniques for Multi-Color Projector Applications

CATEGORY: Exploratory Development

OBJECTIVE: Design and fabricate a prototype Infrared signal combiner which utilizes existing or readily available optical components and significantly reduces signal losses for integration with an IR projector for hardware in the loop simulations.

DESCRIPTION: Several weapon systems are currently under development throughout all branches of DOD which utilize multiple IR wavebands for target detection and intercept. Conventional beam combiner techniques result in large losses in the two projected IR signals. In addition to difficulties in generating the IR signals, these performance limitations have forced the exclusion of the IR detectors from the HWIL simulations which are necessary to adequately assess weapon system performance. Therefore, innovative IR beam combining techniques are needed to overcome these limitations.

Phase I: Provide conceptual design and laboratory demonstration of a novel IR signal combiner which utilizes available optical components and materials.

Phase II: Provide an extension and upgrade of the laboratory demonstration IR signal combiner system for use with an IR projector in HWIL simulations of multi color IR missile systems.

SB92-102 TITLE: Innovative Detection and Tracking Techniques for Missile Seekers Engaging Low Flying and Hovering Aircraft in Clutter

CATEGORY: Exploratory Development

OBJECTIVE: Demonstrate multi mode sensors for detecting and tracking low flying targets in clutter.

DESCRIPTION: The application of this technology is for lock on after launch missiles such as the CORPS SAM concept which would utilize a remotely launched inertially guided missile with periodic up links for guidance corrections and with an autonomous acquisition capability for terminal flight. Approaches to this problem could be to use innovative combinations of sensors and signal processing techniques to enhance detection of low flying targets in clutter. The main challenge is to produce techniques which would allow detection of reduced signature cruise missiles and hovering helicopters and track these vehicles well enough for terminal homing.

Phase I: In this sensor fusion effort, define and analyze candidate concepts for fusing of raw sensor data for detection of targets in clutter and for enhanced tracking.

Phase II: Selected sensor fusion candidates should be tested first using a tower test in which low flying targets are detected using candidate sensors such as active millimeter wave and passive infrared, whose raw data is combined for this purpose. Ultimately, a captive flight test would be performed in which low flying targets are detected using a raw data fusion technique and enhanced tracking is also demonstrated.

SB92-103 TITLE: Innovative Utilization of Interferometric Technology to Demonstrate Precision Transfer Alignment

CATEGORY: Advanced Development

OBJECTIVE: Demonstrate the ability to transfer the alignment from a master navigator to an Inertial Measurement Unit with the Root Sum Squared of the orientation angle errors to be under 0.5 milliradian using available interferometric technology.

DESCRIPTION: A major consideration in the determination of overall missile system performance is the ability to rapidly and accurately transfer the position and orientation information of a master navigator to on board IMUs. This project seeks to explore and exploit currently existing technology in the communication industry, such as integrated optics, fiber optic cabling, and the interferometic effect for this application. Proposed concepts should be capable of providing a significant payoff in cost and manufacturability with minimal impact on system computational demands.

Phase I: Develop system concepts, build a simplified laboratory proof of principle model, and demonstrate performance. Identify performance parameters such as effectiveness, scale factor, accuracy, and noise, along with any noted limitations.

Phase II: Modify the system concept to accommodate lessons learned, implement the concept in a field environment, and evaluate performance parameters and determine advantages/disadvantages of the concept with production cost estimates.

SB92-104 TITLE: Integration of Expert System for Process Planning and Feature Based Designs

CATEGORY: Exploratory Development

OBJECTIVE: Investigate, develop and demonstrate innovative Artificial Intelligence/expert system techniques which integrate feature based designs and process planning considerations.

DESCRIPTION: Artificial Intelligence/expert system techniques have demonstrated the ability to address complex reasoning tasks required for process planning. Feature-based design theory and preliminary efforts have shown the potential of providing a fundamental model for capture and manipulation of design knowledge. However, the two technologies have not been sufficiently integrated to allow design features to automatically influence process planning considerations.

Phase I: Identify and demonstrate innovative Artificial Intelligence/expert system techniques which integrate feature based design and process planning technologies.

Phase II: Based upon Phase I results, provide fundamental model integrating feature based and process planning considerations into a user friendly tool for capture and manipulation of design knowledge.

SB92-105 TITLE: Millimeter Wave Combat Identification Devices

CATEGORY: Exploratory Development

OBJECTIVE: Develop low cost MMW combat identification devices for application to ground vehicles.

DESCRIPTION: Recent events have demonstrated the need for combat identification devices for ground vehicles. MMW operation offers the advantages of battlefield obscurant penetration, operation in adverse weather environments, small package size, and low cost potential. Innovative ideas are sought for the design of millimeter wave cooperative Identification Friend or Foe (IFF) devices. These devices should provide omni directional coverage for the ground vehicle and should be able to operate to beyond six kilometers in range. Proposals should

contain detailed descriptions of the design of the device as well as a description of the interrogator required for the device to operate. Emphasis will be placed on designs that offer low cost potential.

Phase I: Provide detailed analysis of the proposed design including an experimental evaluation plan.

Phase II: Develop hardware and perform laboratory demonstrations to verify the technical approach.

SB92-106 TITLE: Millimeter Wave (MMW) Device Models and Computer Aided Design Techniques for Smart Weapons

CATEGORY: Exploratory Development

OBJECTIVE: Predictive models for MMW devices between 35 and 95 GHz are needed that can relate device performance to the manufacturing process parameters. The final objective is to couple these models with existing CAD software packages and work stations.

DESCRIPTION: The higher frequencies of the millimeter region are needed for smart weapons applications to provide narrow tracking beams consistent with smaller diameters of missiles. Unfortunately, the technology from 35 to 95 GHz is much less mature that the spectral region below 35 GHz, and requires additional investments in research. Although the accuracy of such models is dependent upon the specific circuits, it is reasonable to say that linear models between 1 and 20 GHz are reasonably accurate and mature. The purpose of this work is to achieve a higher level of accuracy and maturity for the millimeter region.

Phase I: Device or circuit configurations relevant for smart weapons application will be selected and models will be developed that predict the device and circuit performance in terms of the manufacturing process parameters.

Phase II: A software program will be written that can be integrated with existing CAD software and work stations.

SB92-107 TITLE: Millimeter Wave Sensor Design for Hypersonic Missile Applications

CATEGORY: Exploratory Development

OBJECTIVE: Develop a terminal homing MMW sensor design for hypersonic missile applications.

DESCRIPTION: Hypersonic missiles are being developed for close combat operation. While these missiles are currently envisioned to be command guided, it is felt that the use of an on board terminal homing strap down sensor will improve the accuracy performance of the missile. Innovative ideas are sought for the design of such a sensor. The hypersonic missile will be used against both air and ground targets. The missile diameter will limit the sensor antenna aperture to no greater than two inches. It is desirable that the frequency band of operation for the sensor be W-band. Special consideration should be given to mitigating the effects of multipath the effects of multipath and clutter to the performance of the sensor, since the missile will be traveling fairly close to ground level when used against ground targets. Consideration should be given to the environmental the hypersonic missile will pose to the sensor. Active or semi active sensor ideas are acceptable and the proposal must include a detailed description of the possible error sources for the sensor and rationale to support any assumptions made in the development of the design. If a semi active sensor design is proposed, then the proposed, then the proposal must also contain a description of the illuminator required for operation of the sensor. Special emphasis will be given to designs which offer low cost potential.

Phase I: Provide detailed analysis of the proposed sensor design including experimental evaluation plan.

Phase II: Develop test hardware and perform laboratory demonstrations, field tests, and hardware in the loop tests to verify the technical approach.

SB92-108 TITLE: Millimeter Wave Infrared Synthetic Scene Gyration Using Fractals

CATEGORY: Exploratory Development

OBJECTIVE: Development of synthetic MMW and IR scenes using fractals which can be used in Digital and hardware in the loop simulations.

DESCRIPTION: Synthetic scene generation of natural backgrounds in used extensively in the evaluation of MMW and IR weapon systems. The ability of the engineer to accurately predict weapon system performance in the absence of real world tests is dependent to a large extent on the accuracy and realism of the model being used. The science of fractals is a relatively new area of mathematics which appears to offer tremendous potential in the synthesis of realistic scenes of the real world. The objective of this task is to use fractals to generate a realistic MMW synthetic aperture radar scene using real SAR images taken at 35 GHz with a DARPA MMW radar developed under the auspices of MIT/LL. Because of the high polarimetric quality of the SAR images, it will be possible to compare the fractal SAR image to simulate the real image.

Phase I: Choose several techniques which appear most promising, and generate synthetic polarimetric 35 GHz SAR images.

Phase II: Compare generated scenes with actual SAR scenes from the MIT/LL database and determine the degree of correlation between synthetic and real scenes. Degree of correlation will be determined by investigating the polarimetic, statistical, and other parameters of the two scenes. In addition, various target detection, false target rejection algorithms using polarimetric data will be run to compare performance between the synthetic and real scenes.

SB92-109 TITLE: Multiple Beam width Millimeter Wave Antenna for Direct Fire Missile Guidance Applications

CATEGORY: Exploratory Development

OBJECTIVE: Develop and demonstrate a multiple bandwidth antenna for use in millimeter command guided direct fire missile applications.

DESCRIPTION: Innovative ideas are sought for the design of an antenna for a MMW command guidance radar application which would have a variable beam width capability. Variable bandwidths would allow early missile capture and precision track of the missile after capture. The missile will possess a transceiver capable of receiving a MMW command guidance signal and the transceiver will also radiate a beacon from the missile to augment the missile's tracking signature. The missile will be the roll stabilized and travel at hypersonic velocity; therefore, the switching between the bandwidths has to be done very quickly in order to avoid losing the missile. A variable bandwidth antenna would also offer the capability to differentially track a fast crossing target and the missile throughout the flight of the missile. The antenna must operate in the W band frequency band, and must have monopulse capability as well as a 1% frequency bandwidths.

Phase I: Provide detailed analysis of the proposed antenna design including experimental evaluation plan.

Phase II: Develop hardware and perform laboratory demonstrations to verify the technical approach.

SB92-110 TITLE: Optical Fiber Development for Military Applications

CATEGORY: Exploratory Development

OBJECTIVE: Optical fiber is required for military applications meeting specific performance and environmental requirements. This advancement in technology will result in the development of a lower cost fiber suitable for Army, Navy and Air Force programs.

DESCRIPTION: Currently available optical fibers meet only a few of the requirements for military applications. The limitations of the technology result in decreased success of demonstration programs and higher cost. A military optical fiber development program should address the following requirements: low intrinsic loss/loss uniformity, bond insensitivity, minimal dispersion, reduction of buffer coating imperfections, decrease of buffer thickness, minimal buffer coating Coefficient of Thermal Expansion, high proof strength, high strength splicing, recoating, operation over military temperatures, static fatigue resistance, aging degradation resistance, radiation resistance/fast recovery, adhesive application, and compatibility with existing sources, detectors, and connectors.

Phase I: The first objective for the proposed task is the development of a detailed specification for an optical fiber meeting military requirements. Trade-off studies shall be performed to investigate the effects of optimizing one parameter over another. Preliminary material and processing studies shall be performed to determine the feasibility of producing an optical fiber meeting the specification.

Phase II: The second phase task is to develop the optical fiber in accordance with the established requirement. The performance characteristics of the fiber shall be evaluated to provide verification that specifications were met. Approximately 100 km of the optical fiber shall be delivered to the Government for further testing and evaluation.

SB92-111 TITLE: Optimal Decision Fusion in Passive Multisensor Target Acquisition

CATEGORY: Exploratory Development

OBJECTIVE: Optimization of sensor fusion processes both at the basic signal processing level and at the decision making level in order to provide improved system reaction time. Attention to the most appropriate target in the minimum time line is critical for fire control platforms. In the multitarget scenario, global sensing to direct local imaging sensors in the most optimal way for wither fire control applications or surveillance will provide for maximum system effectiveness and survivability.

DESCRIPTION: A human operator currently acts on the target acquisition information presented to him on an integrated high resolution graphics screen. The targets on this graphics screen have been detected, recognized, or identified based upon lower level data and feature fusion processes. The optimal decision fusion processes to be developed under this effort may make use of any of the target information generated at any of these levels. There are two selectable modes where the operator can be in manual or automatic mode. Manual mode allows the operator to select which target on the graphically generated ”Would view” screen to cue the Electro-optic (EO) platform. The automatic mode is currently based upon a heuristic process where target priorities are set and then processing proceeds by cueing each target in sequence to the operator. The newly designed decision process shall be capable of providing information to the operator under changing dynamic situations and optimally control the imaging EO sensors cueing position for overall target acquisition efficiency.

Phase I: During this phase an optimal decision fusion methodology shall be developed which is capable of being implemented on a government tested located at the U.S. Army Missile Command’s Sensor Signal Processing Facility (SSP) at Redstone Arsenal, Alabama.

Phase II: The current heuristic decision fusion implementation which is operating on the SSPS shall be replaced using the contractor developed optimal decision fusion implementation and tests shall be conducted to validate the performance improvement over benchmark and test data sets. Several data sets representing different missile fire control platform, surveillance, and target acquisition platform scenarios shall be used by the contractor and government personnel to exercise the contractor implemented optimal decision fusion processes.

SB92-112 TITLE: Parallel Infrated (IR) Magneto Optical Mapper for Semiconductor Material

CATEGORY: Exploratory Development

OBJECTIVE: Demonstrate simultaneous measurement of IR detector material properties over a wafer or film area using Faraday rotation.

DESCRIPTION: Faraday rotation has been demonstrated as noncontact testing technique for characterizing the electronic properties of semiconductor materials to improve the yields of IR detectors. It is a replacement for the Hall technique which required contacts on the sample and is incapable of high resolution. Present Faraday rotation mapping technology requires serial sampling of material area. It is desirable to make Faraday rotation measurements simultaneously over the wafer to rapidly screen material to be used in detector design.

Phase I: Identify approaches for parallel measurement of Faraday rotation in infrared detector material and develop a magneto-optical mapper design. Perform laboratory demonstrations to prove the feasibility of the design.

Phase II: Construct and test a proof-of-principle demonstrator.

SB92-113 TITLE: Perspective Scene Generator/Simulator for Advanced Correlator Analysis

CATEGORY: Exploratory Development

OBJECTIVE: A National Television Standards Committee (NTSC) video-based scene generator is required to analyze the performance of advanced optical correlators for airframe guidance demonstrations.

DESCRIPTION: An NTSC video-based scene generator is required to analyze the performance of advanced optical correlators for airframe guidance demonstrations. The simulator must be capable of interfacing photographs of terrain maps or NTSC video inputs of scenes into a video format. These input photographs will be used to develop a database to simulate flights representative of a helicopter flying over a test region and releasing a visible seeker over the top of a stationary ground target. The input imagery should include stationary military ground targets such as tanks and Armored Personnel Carriers (APC) located on background terrain representative of the foliage of Redstone Arsenal. The imagery database should be used to develop simulated missile flights over the region. These flights will simulate a top down attack on a stationary ground vehicle. The initial altitude of the simulated is 5000 ft and the flight should be simulated to impact. The simulations should account for aspect angles of +/- 25 degrees. The flights should provide a video rate update of the simulated image based on a modeling of the missile dynamics. The output of the simulator should be an NSTC video signal which simulates in real time the top down attack. Furthermore, manual control of zoom and joystick control of azimuth and elevation within the above flight constraints should be available to the user. Equipment suggested for this application includes an input video digitizer/scanner, Central Processing Unit (CPU) processors capable of modeling missile dynamics, and a high resolution black and white NTSC video monitor. It is suggested that the simulation system be rack mounted.

Phase I: The objective of the first phase is to design and specify a prototype system that will interface photographic inputs into a video format. This video imagery will be used to simulate a top down missile attack on a stationary target. The electronics necessary to provide manual control of the zoom and joystick control of azimuth and elevation of a simulated flight should be included in the design and evaluation.

Phase II: The objective of the second phase is to construct and test the prototype designed in Phase I.

SB92-114 TITLE: Polarization Sensitive Infrared (IR) Detectors for Target Discrimination

CATEGORY: Exploratory Development

OBJECTIVE: Demonstrate an array of polarization sensitive IR detectors capable of responding to two or more distinct polarizations in a controllable manner.

DESCRIPTION: It has been established that IR energy radiated or reflected from manmade objects has a larger percent that is polarized than energy radiated or reflected from natural backgrounds. This may provide the basis for target discrimination in IR search and track sets, Forward Looking Infrared Sensors, and IR seekers. The

polarization sensitive IR detectors developed under the program should be capable of being demonstrated in an existing IR instrumentation system.

Phase I: Identify a specific IR detector configuration and the means for polarization control and carry out engineering calculations to demonstrate performance.

Phase II: Construct a polarization controllable IR detector array and demonstrate in an existing IR instrumentation system.

SB92-115 TITLE: Real Time Printing of Fine Line Patterns on Printed Wiring Boards

CATEGORY: Exploratory Development

OBJECTIVE: Investigate innovative methods for high speed direct writing of circuit patterns on printed wiring board photo resists.

DESCRIPTION: Printing of fine line patterns onto photographic masters has been possible for several years. Photo plotters capable of imaging fine lines on film are available form several manufacturers. Transfer of the image from the master to the photo resist on the printed wiring board has been difficult when conventional photo tools and photo resists are used. A possible solution is to image fine line patterns directly onto the photo resist to avoid the problems inherent in the contact printing approach used to transfer images from the photo tool. Several companies have developed laser direct imaging systems, similar to laser photo plotters. These imaging systems had two inherent problems: the lasers used in these systems were inefficient and unreliable, and laser replacement was expensive. The systems were very slow due to the large number of pixels required in the generation of a fine line pattern. To make direct imaging systems compatible with conventional printed wiring board lines, it will be necessary to print patterns at a rate of 5 to 6 square feet per minute with a .2 mil resolution.

Phase I: Evaluate various methods of achieving the speed required for real time imaging of circuit patterns on printed wiring board photo resists. Evaluate the preferred approach in a breadboard assembly. Complete a design concept for a full scale real time imaging system.

Phase II: Complete the detail design and build a prototype system capable of real time printing of fine line patterns on printed wiring boards.

SB92-116 TITLE: Tank-Mounted Millimeter Phased Array Radar for Self-Define

CATEGORY: Exploratory Development

OBJECTIVE: Develop a design and demonstrate the millimeter wave component and device technology for a tank mounted MMW radar that can detect and track projectiles that represent a threat to the tank.

DESCRIPTION: The program will focus on monolithic W-Band components that can be assembled into a subassembly of the array for test and evaluation. The overall goal is to achieve a lightweight, reduced aperture size phased array consistent with the low profile design of the tank. The program should capitalize to the maximum extent possible on the investments being made in the millimeter wave integrated circuits program to achieve the goal of affordability.

Phase I: The first effort will be to conduct component design trade-off studies within the system constraints to choose the specific phased array concept that also takes into account cost and affordability.

Phase II: A number of fundamental elements of the phased array that can be assembled into a sub-element will be fabricated as the vehicle for demonstrating the basic feasibility of the concept.

SB92-117 TITLE: Wavelet-Transform Representation of High Range Resolution Radar (HRR) Signatures

CATEGORY: Exploratory Development

OBJECTIVE: Investigate the potential for data compression of HRR signatures with wavelets.

DESCRIPTION: The number of HRR signatures required for radar target identification is enormous; moreover, each signature has enough structure to require a fair amount of computer memory. Hence, signature storage and retrieval pose a major computational problem for HRR target identification. The data compression achieved by wavelet representations in other areas of signal analysis suggests that wavelet transforms could be useful in radar signal analysis.

Phase I: Develop the rationale for applying wavelet theory to radar signal analysis and establish the feasibility for achieving data compression of HRR signatures using wavelet transforms.

Phase II: Develop algorithms for HRR signature storage and retrieval by means of wavelet transforms.

SB92-118 TITLE: Advanced Timing Concepts for Satellite Networks

CATEGORY: Advanced Development

OBJECTIVE: Evaluate system level timing requirements and concepts for advanced space networks which link multiple satellites together with ground and air based platforms. Identify timing technology deficiencies and develop alternative technologies to correct these deficiencies.

DESCRIPTION: Define and examine timing requirements and design issues for future advanced space applications to include, at a minimum, global networking for navigation, sensor, and C3 platforms. Advanced clocks, measurement systems and techniques, and timing synchronization and management approaches will be assessed to determine if technology shortfalls exist. Technology road maps will be developed to suggest ways to overcome any deficiencies, and critical technology development will be initiated.

Phase I: Assess system level timing requirements for advanced space networks which link multiple satellites, ground and air based platforms. Identify timing technology shortfalls based on the system level assessment. Formulate a timing technology road map that will show the investment path required to correct identified deficiencies.

Phase II: Refine system timing concepts and initiate development of critical timing technologies as identified in Phase I.

SB92-119 TITLE: Positive Combat Identification

CATEGORY: Exploratory Development

OBJECTIVE: Develop suitable methods to discriminate between friendly and enemy forces during combat.

DESCRIPTION: The recent Persian Gulf War highlighted the problems and ratifications associated with unambiguously discriminating between friendly and enemy forces. The problem is complicated by the fact that identification must be accomplished very rapidly, in the heat of battle, during conditions of limited visibility, at extended stand-off ranges, and between enemy and friendly forces with identical equipment. Positive identification means are sought that are very inexpensive, highly fool proof, not useful to opposing forces to assist in location or identification of U.S./allied forces, and not conducive to counterfeiting or mimicry.

Phase I: Develop methodology and concepts.

Phase II: Provide initial proof of principle demonstration.

SB92-120 TITLE: Seismic Waveform Character Representation

CATEGORY: Exploratory Development

OBJECTIVE: Develop and test novel methods to more completely represent the character of seismic signals needed for optimum performance of the Intelligent Monitoring System (IMS) at the Defense Advanced Research Projects Agency (DARPA) Center for Seismic Studies.

DESCRIPTION: Methods are sought for a more complete representation of the character of the seismic signal than current detection features. This project is aimed at developing methods to improve automatic measures of onset time for regional signals. We know that analysts are influenced by the envelope shape in signal timing and phase identification. Current automated methods are not very good at determining regional signal onset time. Perhaps some kind of waveform correlation would work better than current methods. The methods are to be tested using the IMS at the DARPA Center for Seismic Studies in Arlington, VA.

Phase I: Provide a detailed description of the proposed concepts, together with a detailed plan for incorporating these concepts into the IMS and testing them with data from a seismic network in Eurasia.

Phase II: Develop software to test the new concepts using the IMS, conduct test in cooperation with the analysis and research staff at the Center for Seismic Studies, using a large amount of data from seismic arrays and single stations in Eurasia, and evaluate the results.

SB92-121 TITLE: Genetic Algorithm (GA) Machine Learning of Seismic Waveform Characteristics

CATEGORY: Exploratory Development

OBJECTIVE: Develop and test a GA approach to the problems of implementing machine learning techniques needed for optimum performance of the Intelligent Monitoring System (IMS) at the Defense Advanced Research Projects Agency (DARPA) Center for Seismic Studies.

DESCRIPTION: We are working with knowledge based systems that represent knowledge with rules, and we are developing techniques for knowledge acquisition that are compatible with this architectures. These techniques are complicated and require much specialized human labor. Some advances are being made with neural nets, which provide the potential for simpler and more straightforward knowledge acquisition (learning). A promising technique that has not been tried is based on GA. It is desired to develop a GA approach to the same problems being addressed by rule-based and neural net approaches.

Phase I: Provide a detailed description of the proposed concepts, together with a detailed plan for incorporating these concepts into the IMS and testing them with data from a seismic network in Eurasia.

Phase II: Develop software to test the new concepts using the IMS, conduct tests in cooperation with the analysis and research staff at the Center for Seismic Studies, using a large amount of data from seismic arrays and single stations in Eurasia, and evaluate the results.

SB92-122 TITLE: Rules from Neural-Nets for Seismic Source Region Specific Knowledge

CATEGORY: Exploratory Development

OBJECTIVE: Develop and test novel machine learning techniques to gather the station and source region specific knowledge needed for optimum performance of the Intelligent Monitoring System (IMS) at DARPA Center for Seismic Studies.

DESCRIPTION: DARPA has developed an IMS which applies rule and case based reasoning to automatically extracted features of data from a network of seismic stations to locate and identify small earthquakes and explosions. The system incorporation audit trails to facilitate performance evaluation and knowledge acquisition. This project is aimed at developing novel machine learning techniques that would enable seismologists to effect a steady and controlled increase in the cognitive capability of the IMS to automatically analyze seismic data. The rules are attractive because they include physics. Neural-nets are good because the knowledge acquisition process is easier. This effort is to combine the two by training a neural-net, then extracting the rules that represent the patterns it finds.

Phase I: Provide a detailed description of the proposed concepts, together with a detailed plan for incorporating these concepts into the IMS and testing them with data from a seismic network in Eurasia.

Phase II: Develop software to test the new concepts using the IMS, conduct tests in cooperation with the analysis and research staff at the Center for Seismic Studies, using a large amount of data from seismic arrays and single stations in Eurasia, and evaluate the results.

SB92-123 TITLE: Automatic Contrail Detection & Avoidance/Elimination

CATEGORY: Exploratory Development

OBJECTIVE: Develop means to eliminate contrail production in aircraft.

DESCRIPTION: Low observable operations are thwarted when contrails are produced. Concepts are sought for innovative means to automatically detect when an air vehicle is producing, or is likely to produce, a contrail, and establish means to avoid or eliminate the contrail.

Phase I: Identify means to detect the presence of a contrail or the environmental conditions that can produce contrails. Identify potential means to avoid/eliminate contrail production.

Phase II: Develop and verify measurement and avoidance/elimination equipments identified in Phase I.

SB92-124 TITLE: Electric Propulsion System

CATEGORY: Exploratory Development

OBJECTIVE: Investigate, develop, and demonstrate innovative methods of electric propulsion for unmanned air vehicles (UAVs).

DESCRIPTION: Interest exists in electric propulsion concepts which would be compatible with a wide variety of subsonic aircraft, including long endurance systems operating at high altitudes. Specifically, new concepts are desired for advanced, lightweight, reliable variable speed electric fans capable of achieving high overall propulsive efficiencies. The applications currently of interest require lightweight electric motors with outputs on the order. The variable speed electric fan must be efficient at altitudes from SL to 50 KFT. Overall system reliability should be compatible with long duration flights possible with mission times on the order of 100 hours. In terms of an installed system, electrical power would be produced using turbine driven 270V DC generators. The key to developing efficient electric propulsion for long endurance systems lies in the development of efficient, lightweight electric fans.

Phase I: Identify electric motors and fans that could efficiently provide propulsion for UAVs up to 50 KFT at 250 shp.

Phase II: Develop and demonstrate prototype equipments as proof of concept for the electric propulsion system.

SB92-125 TITLE: Optical Interconnect Technology

CATEGORY: Basic Research/Exploratory Development

OBJECTIVE: Develop materials and processes for optical interconnect of electronic multichip modules (MCMs).

DESCRIPTION: Concepts, materials, processes, and devices are sought for optical interconnect of MCMs. In principle, optical interconnect offers numerous potential advantages relative to electrical interconnect for high speed/bandwidth MCM-MCM interconnect, and perhaps for the longer signal lines within MCMs. These include high density with lower crosstalk, immunity to electromagnetic interference, wider bandwidth, and lower power consumption.

Phase I: Develop interconnect concepts. Perform preliminary analysis or experimentation of materials and processes.

Phase II: Investigate promising materials and processes. Fabricate optical interconnect test structure and measure electrical/optical performance.

SB92-126 TITLE: Full-Scale Control Surface Lift, Drag, and Torque Measuring Devices

CATEGORY: Exploratory Development

OBJECTIVE: Develop a full-scale force and torque measurement device.

DESCRIPTION: DARPA is interested in developing and demonstrating full scale instrumentation for measuring control surface forces and torques. Methods have been developed at laboratory scale for measuring small forces and moments. DARPA has identified the need to develop instrumentation for full scale submarines in order to use the data for computational fluid dynamics and maneuvering prediction code validation. Currently, no method exists to accurately measure the large scale forces, moments, and torques on submarine control surfaces. Current systems are not scalable to full-scale. A full-scale measurement system would provide, for the first time, the critical data needed to support DARPA's efforts in the development of CFD codes for computation of the highly complex, incompressible, and high Reynolds number submarine flows.

Phase I: Preliminary design of measurement system.

Phase II: Large-scale demonstration of measurement system.

SB92-127 TITLE: Low Lift, Low Drag, Very Low Aspect Ratio Control Appendages

CATEGORY: Exploratory Development

OBJECTIVE: Design concepts for appendages and fairings on bodies of revolution.

DESCRIPTION: DARPA is interested in developing innovative concepts for fairing and appendage designs which provide platform system and operational support without impacting ship propulsive, maneuvering, or acoustic performance. The example of the submarine sail "snap roll" problem, encountered when a submarine turns, is a specific case of an appendage whose lift contribution impacts the maneuvering trajectory. DARPA wants to explore innovative fairing and appendage designs which can offer fairing and/or operational systems support while reducing any potentially adverse control force contributions, reducing the turbulence/vorticity inflow into the propulsor, and eliminating the detectable non-acoustic wake and vorticity. Any concepts must be demonstrated to be applicable for large Reynolds number, incompressible flows.

Phase I: Analysis of conceptual designs.

Phase II: Experiment to demonstrate proof-of-concept.

SB92-128 TITLE: Blunt Body Separation Control and Vorticity Management and Concept Development

CATEGORY: Exploratory Development

OBJECTIVE: Develop separation delay and vortex control techniques for large scale blunt bodies which can develop high angles of attack while maneuvering.

DESCRIPTION: DARPA is investigating innovative concepts for passive or active control of separation and reduced vortex generation on blunt bodies at high angles of attack. For example, hull separation on the blunt after body of submarines during maneuvers causes large body forces which impact predictable maneuvering control and subsequently, ship safety. Reliable methods for delaying separation using distributed passive or active controllers would greatly alleviate this problem. In addition, flow separation and vortex ingestion of shed vorticity by the propulsor are extremely acoustically noisy evolutions. These methods should be simple from the standpoint of control systems for active control and potential retractable passive designs. Although they may be demonstrated at small-scale they must be applicable to the high Reynolds number, incompressible flows of submarine like bodies.

Phase I: Design and analysis of separation and vorticity control techniques.

Phase II: Large-scale experiment to demonstrate proof-of-concept.

SB92-129 TITLE: Simultaneous, Multi-point, Off-body Flow Measurement Techniques for Unsteady, Very High Reynolds Number Flows

CATEGORY: Exploratory Development

OBJECTIVE: Develop a capability to measure simultaneous, multi-point, off-body velocities and pressures for unsteady, high Reynolds number flows.

DESCRIPTION: DARPA is developing simultaneous, multi-point flow measurement capabilities utilizing laser illuminated, neutrally buoyant particulate. These techniques are needed to measure the highly unsteady, complex vertical flows of maneuvering submarines. At laboratory scale, these methods currently require extremely labor intensive set up, including seeding of the flow field of interest, detailed laser and camera alignment, and exhaustive post processing of data images. DARPA desires, for large scale flow measurement applications, to develop innovative techniques such as those that measure naturally or chemically reactive aspects of the flow environment to preclude the introduction of particulate matter and to provide a non-intrusive measurement technique. An example may be the sensing and processing of a particular quantum state of flow environment molecules or naturally occurring isotopes, etc.

Phase I: Laboratory demonstration of measurement technique.

Phase II: Laboratory demonstration of measurement technique.